FlightSafety international

CITATION V ULTRA PILOT TRAINING MANUAL

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THIS PUBLICATION CONSISTS OF THE FOLLOWING:

Page No.	*Revision No.
Cover	0
Copyright	0
i—vi	0
1-i—1-12	0
2-i—2-20	0
3-i—3-10	0
4-i—4-8	0
5-i—5-14	0
6-i—6-ii	0
7-i—7-18	0
8-i—8-8	0
9-i—9-6	0
10-i—10-18	0
11-i—11-14	0
12-i—12-8	0
13-i—13-12	0
14-i—14-20	0
15-i—15-14	0
16-i—16-98	0
17-i—17-8	0
18-i—18-22	0
19-i—19-16	0
20-i—20-128	0
21-i—21-10	0
WA-1—WA-22	0
APP A-1—APP A-4	0
APP B-1—APP B-2	0
APP C-1—APP C-50	0
APP D-1—APP D-142	0
ANN-1—ANN-2	0

*Zero in this column indicates an original page.

NOTICE

The material contained in this training manual is based on information obtained from the aircraft manufacturer's Airplane Flight Manual, Pilot Manual, and Maintenance Manuals. It is to be used for familiarization and training purposes only.

At the time of printing it contained then-current information. In the event of conflict between data provided herein and that in publications issued by the manufacturer or the FAA, that of the manufacturer or the FAA shall take precedence.

We at FlightSafety want you to have the best training possible. We welcome any suggestions you might have for improving this manual or any other aspect of our training program.

FOR TRAINING PURPOSES ONLY

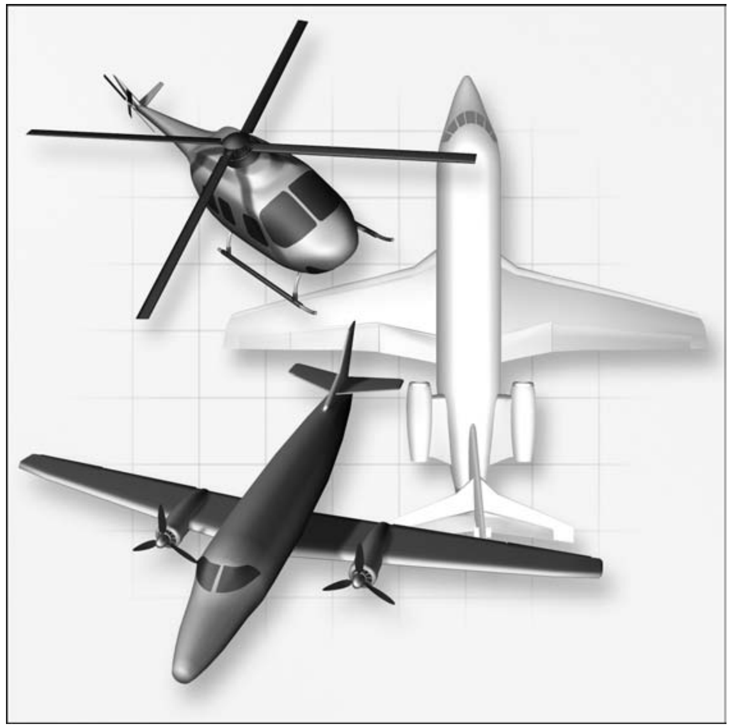
CONTENTS

CHAPTER 1
AIRCRAFT GENERAL

CONTENTS

ILLUSTRATIONS

CHAPTER 1
AIRCRAFT GENERAL



INTRODUCTION

This training manual provides a description of the major airframe and engine systems installed in the Cessna Citation V Ultra aircraft. The information contained herein is intended only as an instructional aid. This material does not supersede, nor is it meant to substitute for, any of the manufacturer's maintenance or operating manuals. The material presented has been prepared from current design data. Chapter 1 covers the structural makeup of the aircraft and gives an overview of the systems.

An annunciator section in this manual displays all annunciator and other light indications and should be folded out for reference while reading this manual. Review questions are contained at the end of most chapters. These questions are included as a self-study aid, and the answered can be found at the back of the book.

GENERAL

The Citation V Ultra, UNs 260 and subsequent, is certified in accordance with FAR Part 25 airworthiness standards and utilizes the fail-safe construction concept. It combines systems simplicity with ease of access to reduce maintenance requirements. Low takeoff and landing speeds permit operation at small and unimproved airports. Medium bypass turbofan engines contribute to overall operating efficiency and performance.

The minimum crew requirements for operations in the Citation V ULTRA are one pilot and one copilot. The pilot-in-command must have a Citation type rating and meet the requirements of FAR 61.58 for two-pilot operation. The copilot shall possess a multiengine rating and meet the requirements of FAR 61.55.

STRUCTURES

The Citation V ULTRA (Figure 1-1) is a pressurized low-wing monoplane. Two Pratt and Whitney Aircraft of Canada Limited JT15D-5D turbofan engines are pylon mounted on the rear fuselage.

Figure 1-2 shows a three-view drawing of the Citation V ULTRA containing the approximate exterior and cabin dimensions. Figure 1-3 shows braking taxi turning distance, and Figure 1-4 is a diagram of engine hazard areas.

NOSE SECTION

The nose section is an unpressurized area containing the avionics compartment, an equipment area, and a baggage storage area. The avionics area is accessible through a removable radome. The radome can be lifted off after releasing one quarter inch drive type lock on each side of the forward nose baggage compartment and one quarter inch drive lock ahead of the pilot and copilot pitot tubes. The baggage compartment has two swing-up doors hinged at the upper edge.

The nose baggage doors incorporate two latches and one mechanical lock each. The door locking system operates a microswitch in each key lock assembly which is connected to the LH or RH BAGGAGE DOOR not locked warning circuit. A manual light switch is located in the compartment. When both nose compartment doors are closed, and both door hinge assemblies attached to the pneumatic cylinders

Figure 1-1. Cessna Citation V Ultra (UNs 0260 and Subsequent)

AIRFOILS	
WING	
WS 30.07	CESSNA 5501
WS 311.02	CESSNA 5504
VERTICAL TAIL	
WL 132.60	NACA 0012
WL 236.45	NACA 0008
HORIZONTAL TAIL	
SS 20.00	NACA 0010
SS 133.00	NACA 0008
INCIDENCE	
WING	
WS 30.07	+3.16°
WS 311.02	–52°
HORIZONTAL TAIL	
BL 0.00	–0° 7'
DIHEDRAL	
WING	4°
HORIZONTAL TAIL	9°
ENGINE PYLON	2°

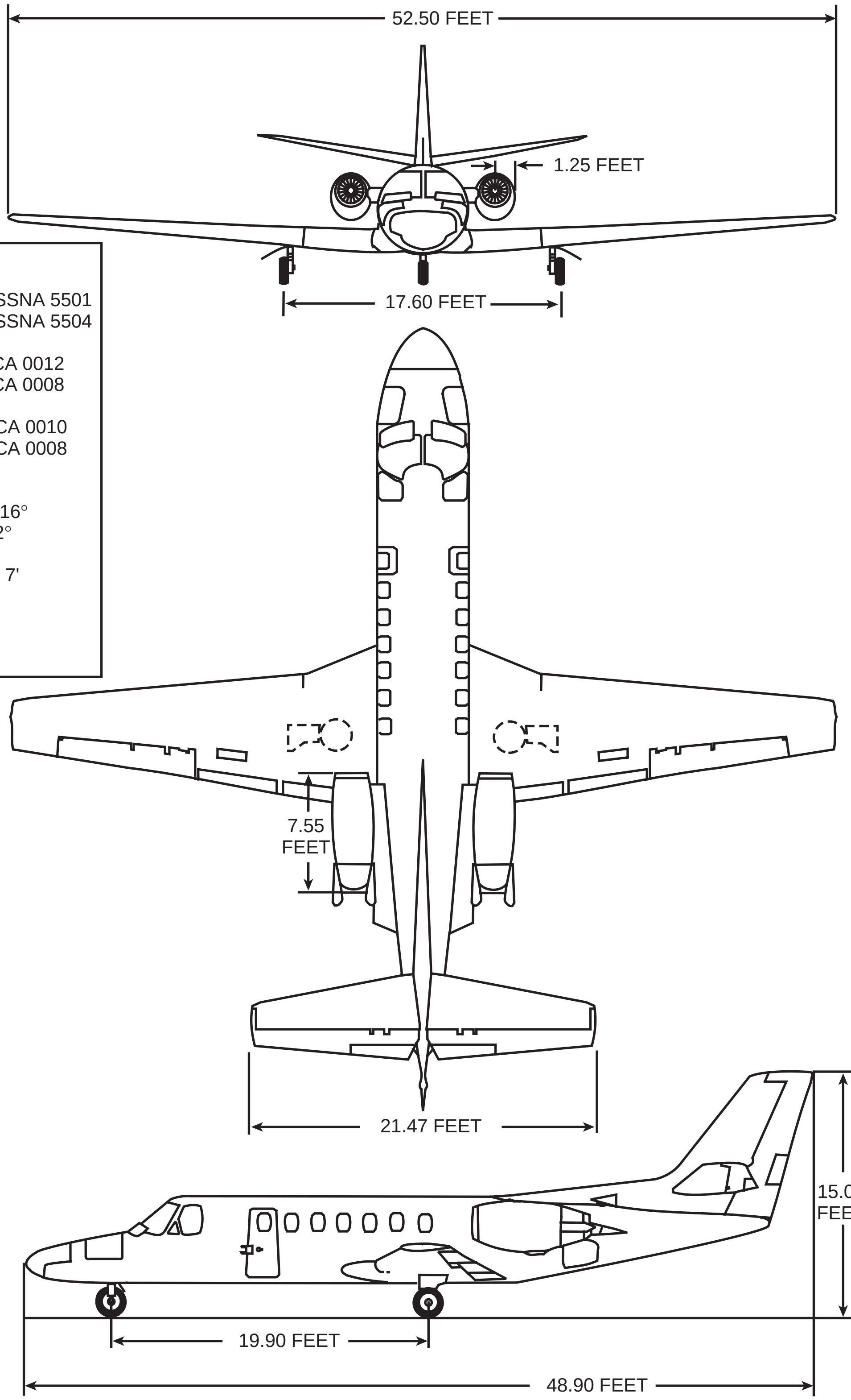


Figure 1-2. Exterior Three-View Drawing

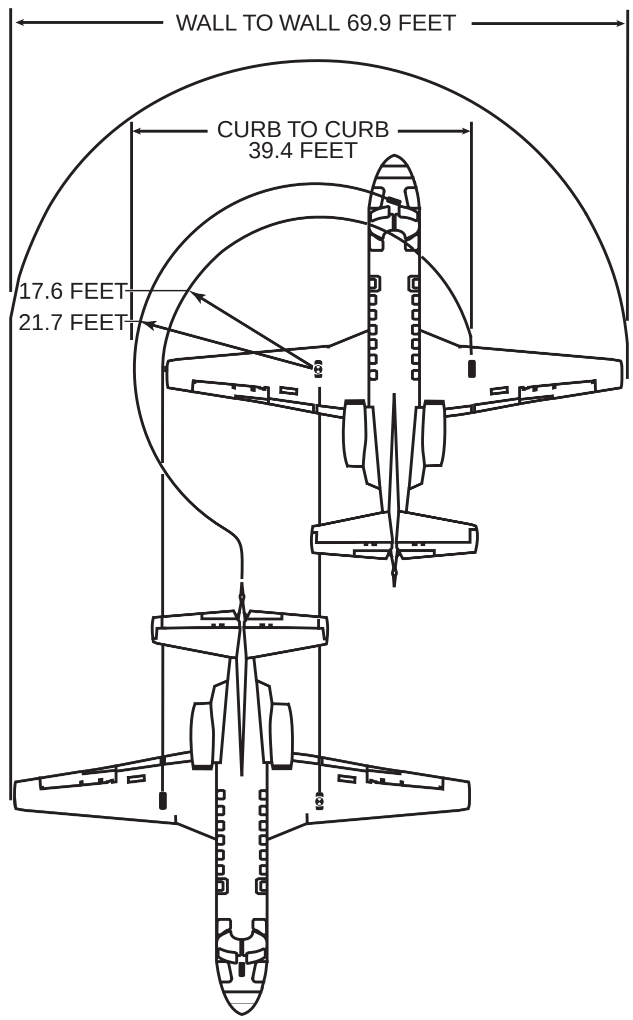


Figure 1-3. Braking Taxi Turning Distance

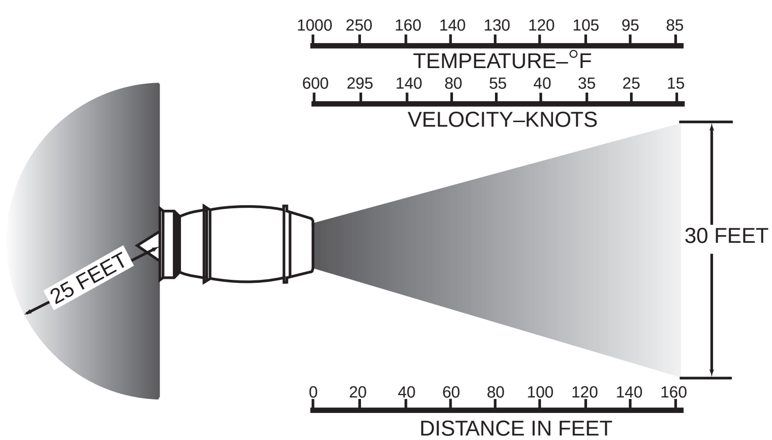


Figure 1-4. Engine Hazard Areas

(Figure 1-5) strike their respective microswitches, this opens the nose compartment light circuit and extinguishes either the courtesy switchlight or the nose compartment light.

CAUTION

Ensure that the key is removed prior to flight to prevent possible ingestion of the key into an engine.

Figure 1-5. Baggage Door Lifters (Pneumatically Opened)

A pneumatic cylinder on each door holds the door in the fully open position. The brake reservoir, power brake accumulator, and digital antiskid control box are located behind the left aft bulkhead of the nose baggage compartment.

The alcohol and pneumatic bottles are located behind the right aft bulkhead of the nose baggage compartment (Figure 1-6).

FLIGHT COMPARTMENT

Two complete crew stations are provided with dual controls, including control columns, adjustable rudder pedals, and brakes. There are two fully adjustable seats with seat belts and shoulder harnesses.

The foul weather window on the pilot side can be opened, as seen in Figure 1-7.

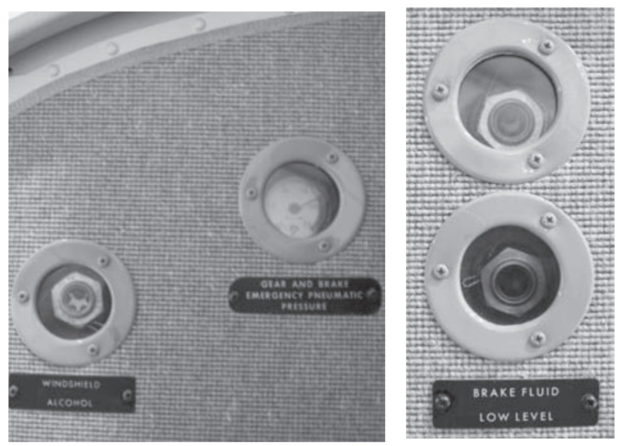


Figure 1-6. Sight Gauges

Figure 1-7. Pilot Foul Weather Window

ENTRANCE DOOR AND EMERGENCY EXIT

The entrance door opens outboard and is held open by a mechanical latch. (Figure 1-8.) A latch release is located in the interior of the cabin on the forward edge of the door opening, next to the light switch. This PULL TO RELEASE lever allows the door to be closed.

The entrance door is secured in the closed position by twelve locking pins attached to a handle. The handle linkage can be operated from the inside or outside of the door. The exterior handle can be secured with a key lock for security. The lower forward locking pin activates a microswitch in the door warning circuit that illuminates the CABIN DOOR not locked annunciator light whenever the door is not closed and secured. The door also incorporates five indicator windows in the locking system to show a visual closed-and-locked condition. (Figure 1-9.) When the door is closed and locked, the lower forward locking pin depresses a plunger. This opens a valve to allow bleed air to inflate the pneumatic cabin door seal, which is installed in the door perimeter to prevent cabin pressure loss.

If the door seal loses inflation pressure, the DOOR SEAL annunciator illuminates. Cabin pressurization can not be lost, because the secondary seal (which is not inflatable) holds the cabin pressure.

An emergency exit, located opposite the entrance door on the right side of the fuselage (Figure 1-10), opens inboard. It is a plug-type door installation and has a provision for inserting a locking pin to prevent unauthorized entry while the aircraft is on the ground. The pilot must ensure that this pin is removed prior to flight. Both the cabin entrance door and emergency exit door can be opened from either outside or inside the aircraft. The emergency exit door is not connected to the door warning circuit.

CABIN

The cabin extends from the forward to the aft pressure bulkhead and measures approximately 22.5 feet in length, 5 feet in width, and 5 feet in height. The cabin baggage compartment is located aft of the rear seats and has a capacity of 600 pounds. Figure 1-11 shows the various interior arrangements.

Additional baggage storage is available in the nose compartment and in the tail cone. A typical interior arrangement consists of seven passenger seats plus two pilot seats and a toilet. The cabin area is provided with dropout, constant-flow oxygen masks for emergency use. The cabin overhead panels contain individual air outlets and seat lighting for passenger comfort. Indirect lighting for the cabin is provided by two rows of fluorescent bulbs running the length of the cabin, controlled by a switch near the cabin entrance.

Figure 1-8. Entrance Door, Pins, Interior Handle and Latch Release

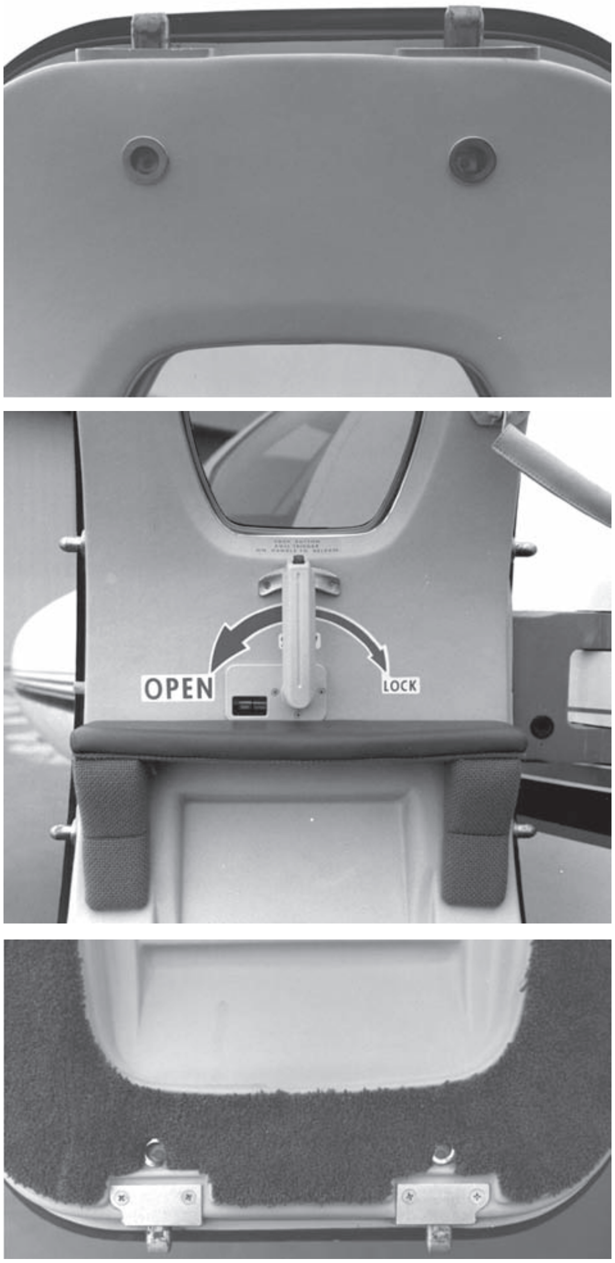


Figure 1-9. Door Locking Indicator Windows

WING

The wing consists of two sections attached to 30-inch center section stubs which are part of the fuselage carry-through structure. Each wing is a fuel tank. Speedbrakes and flaps are also on each wing (Figure 1-12).

EXTERIOR

INTERIOR

Figure 1-10. Emergency Exit

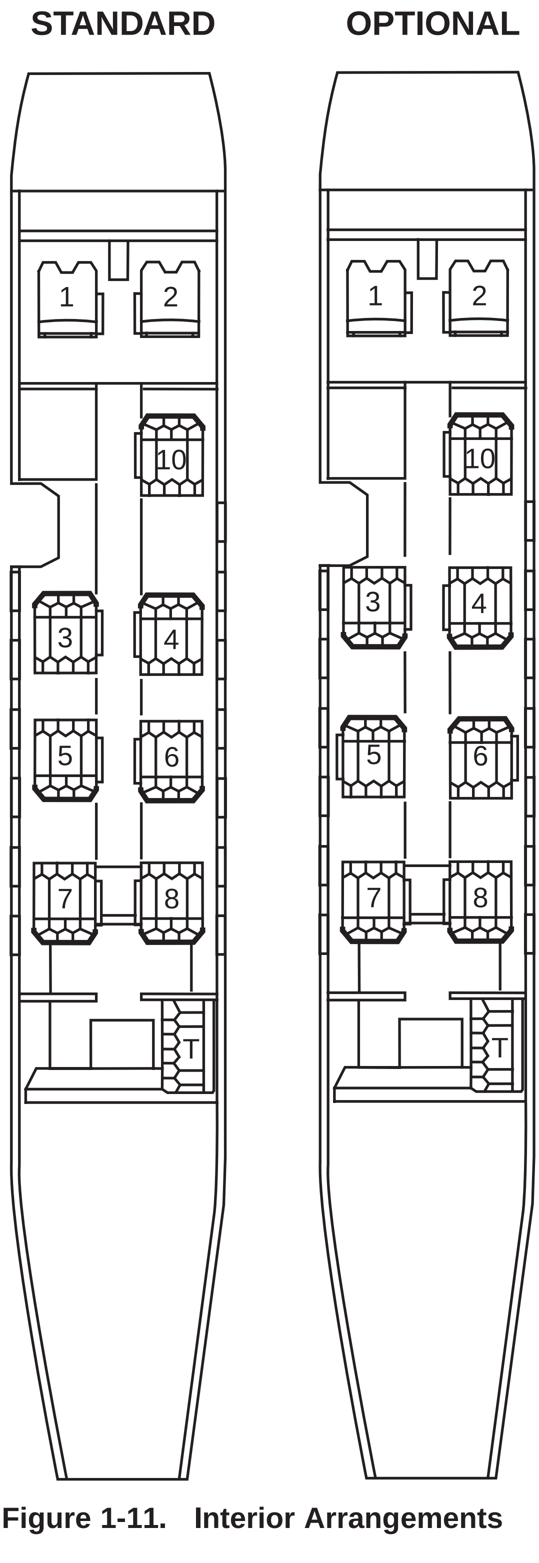


Figure 1-11. Interior Arrangements

Figure 1-12. Wing Trailing Edge

Figure 1-13. Wing Leading Edge

The leading edges of the wing (Figure 1-13) has two sections protected against ice buildup. The wing leading edge forward of the engines is anti-iced by bleed-air heat, while the remainder of the leading edge is deiced by inflation of rubber deicer boots with engine bleed air. Stall strips are attached to both the bleed-air panels and the deicer boots.

TAIL CONE COMPARTMENT

The tail cone compartment is an unpressurized area and contains the major components of the hydraulic, environmental, electrical distribution, flight controls, and engine fire extinguishing systems. Access is through an entrance door on the left side of the fuselage below the engine. This entrance door is to the tail cone baggage compartment (Figure 1-14) and entrance to the rest of the tail cone is via a door on the forward bulkhead of the baggage compartment.

The tail cone compartment door is secured at the top by two mechanical latches and a key lock and is hinged at the bottom.

A microswitch, operated by the key lock, is connected to the TAILCONE DOOR not locked warning circuit. A light switch on the forward edge of the door opening is powered from the hot battery bus and provides illumination of the tail cone area for preflight inspection purposes. A microswitch, installed in the door track, extinguishes the light when the door is closed if the manual switch is left on.

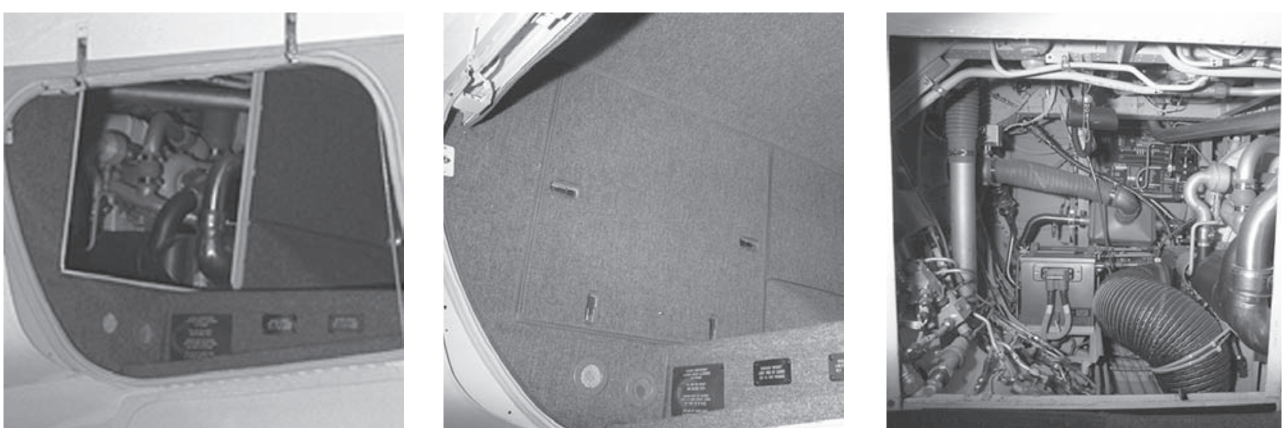


Figure 1-14. Tail Cone Baggage Compartment

EMPENNAGE

The empennage consists of a vertical stabilizer, horizontal stabilizers, and a dorsal fin. (Figure 1-15.)

The leading edges of the horizontal stabilizers are deiced by rubber boots. The dorsal fin, attached to the top side of the rear fuselage, has a ram-air duct to provide air for use in the aircraft air cycle machine heat exchangers and the windshield bleed-air heat exchanger.

Figure 1-15. Empennage

SYSTEMS

ELECTRICAL SYSTEM

The aircraft DC buses are supplied from two starter-generators. Engine starting and secondary DC power is available from either the battery or an external source. Two static inverters provide AC power.

FUEL SYSTEM

The fuel system has two distinct, identical halves. Each wing tank stores and supplies the fuel to its respective engine, but crossfeed capability is incorporated. All controls and indicators are located in the cockpit.

ENGINES

Two United Aircraft (Pratt and Whitney) JT15D-5D turbofans, installed on pylons mounted on the rear fuselage, produce 3,045 pounds of thrust each. Ice protection, fire detection, and extinguishing systems are incorporated. Target-type thrust reversers are individually operated by conventional "piggyback" controls mounted on the throttles.

ICE PROTECTION

Ice protection for the wings and horizontal stabilizer leading edges is provided by heated inboard panels on the wings, and by deicer boots on the outboard portion of the wings and the horizontal stabilizers. Engine compressor bleed air heats the engine nose cone, nacelle inlet, T1 temperature probe, and the first set of stator vanes on each engine. Engine bleed air can be discharged through nozzles directed at the front of the windshields. Isopropyl alcohol is available to anti-ice the left windshield in the event that bleed-air is not available. Electrical heaters are employed by pitot-static and angle-of-attack sensors. All bleed-air and electrical anti-ice systems should be turned on prior to operation in visible moisture when the RAT is +10°C and below.

HYDRAULIC SYSTEM

Engine-driven pumps supply pressure for operation of the landing gear, speedbrakes, flaps, and thrust reversers through an open center system. The main gear are equipped with antiskid controlled wheel brakes, operated hydraulically from a separate hydraulic system. Pneumatic backup is available for landing gear extension and braking.

FLIGHT CONTROLS

Primary flight control is accomplished through conventional cable-operated surfaces. Trimming is provided by aileron, elevator, and rudder tabs. The elevator trim tabs are both mechanically and electrically actuated.

Hydraulically operated speedbrakes are installed on the upper and lower wing surfaces and Fowler flaps are installed on the trailing edges. Nosewheel steering is mechanically controlled by the rudder pedals.

ENVIRONMENTAL CONTROL

Cabin pressurization utilizes bleed air from the engines which is conditioned by an air-cycle machine. Temperature is controllable and the system provides sufficient pressure to maintain sea level pressure up to an approximate altitude of 23,000 feet, and approximately 8,000-feet cabin pressure at a cruise altitude of 45,000 feet.

These pressures are based on a pressure differential of 8.9 psi. The oxygen system supplies the cockpit through quick-donning masks and the cabin through dropout masks automatically deployed in the event of excessive cabin altitude.

AVIONICS

The standard, factory-installed avionics package includes weather radar, dual altitude-reporting transponders, and a Primus 1000 integrated flight director system which incorporates the autopilot. Communication is provided by two VHF transceivers. Navigation equipment includes a digitally tuned ADF, dual DMEs, and VOR/localizer/glideslope/marker beacon receivers. A GNS-X/ES flight management system is installed on the center pedestal. The pilot and copilot positions have dual EFIS and a multifunction display on the center instrument panel. ELT, CVR, and Flitefone VI are standard equipment.

PUBLICATIONS

The FAA Approved *Airplane Flight Manual (AFM)* is a required flight item. It contains the limitations, operating procedures, performance data pertinent to takeoffs and landings, and weight and balance data. It does not contain enroute performance information. The f-gravity location are all contained in the always takes precedence over any other publication.

The Citation Operating Manual contains expanded descriptions of the aircraft systems and operating procedures. It contains enroute flight planning information as well as some takeoff and landing performance information.

The Cessna checklist contains abbreviated operating procedures and abbreviated performance data. If any doubt exists or if the conditions are not covered by the checklist, the *AFM* must be consulted.

The Citation Weight and Balance Manual contains detailed information in the form of tables and diagrams. However, it is not required to be in the aircraft as the basic empty weight and moment and means of determining the center-of-gravity location are all contained in the *AFM*.

The *Honeywell Primus® 1000 Integrated Avionics System* for the Citation Ultra Manual is a required flight item. It contains operating procedures for use of the two Primary Flight Displays and Display Controllers and the Multifunction Display with MFD and Radar Controllers. Complete operational procedures for use of the Flight Directors Mode Panel and Autopilot Controller are included.

The *Allied Signal Aerospace Global Wulfsberg GNS-X/ES Operator's Manual* is a required flight item. It describes operational procedures for use of the flight management system (FMS), its equipment, capabilities, and its operation. How to initialize, select or build a flight plan, and navigate using the various installed standard or optional sensors; such as VPU, GPS, VLF/OMEGA, LORAN C System, or INS/IRS. Optional AFIS is also described. The GNS-XLS is also available.

CHAPTER 2
ELECTRICAL POWER SYSTEMS

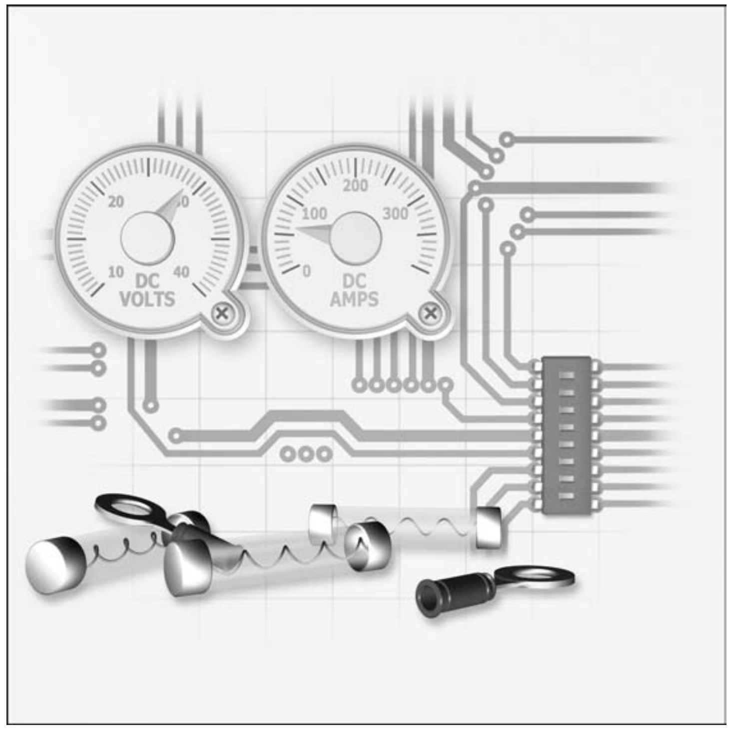
CONTENTS

Page

ILLUSTRATIONS

TABLES

CHAPTER 2
ELECTRICAL POWER SYSTEMS



INTRODUCTION

This chapter provides a description of the electrical power system used on the Citation V Ultra aircraft. Included is information on the DC and AC systems. The DC system consists of storage, generation, distribution, and system monitoring. The AC system consists of generation, distribution, and system monitoring. Provision is also made for a limited supply of power during emergency conditions in flight and connection of an external power unit while on the ground.

GENERAL

Direct current provides the principal electric power for the Citation V ULTRA. Two generators are the primary power sources; as secondary sources, battery or external power may also be utilized. Normal distribution of DC power is via three left and three right buses connected by a tie bus. This arrangement allows either generator to power the entire system or, working in parallel, to share the system load. The hot battery and emergency buses are normally tied to the main system, but may be isolated to only the battery or external power sources. When the aircraft is on the ground, an external DC power source (EPU) may be utilized to supply electrical power to the buses.

DC POWER

BATTERY

A standard 20 cell, 40 amp-hours nickel-cadmium battery provides 25-volt power. The battery, in the tail cone compartment (Figure 2-1), is provided with a manual quick-disconnect and is accessible through the tail cone door. The battery is always connected to the hot battery bus. It is susceptible to, and must be protected from, overheat due to excessive charging. Therefore, use of the battery is limited to three engine starts per hour. During an external power start, the battery is separated from its ground to prevent battery discharge during the start cycle. Consequently, a start using an external power unit is not considered a battery start. A battery in good condition should supply power to all buses for approximately10 minutes. If only the hot battery and emergency buses are powered, battery life should be approximately 30 minutes.

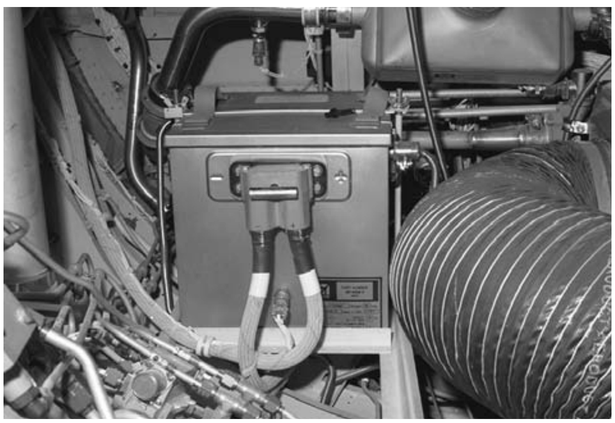


Figure 2-1. Battery Location

STARTER-GENERATORS

Two engine-driven DC starter-generators, one mounted on each engine accessory gearbox, are the primary source of power and supply all DC buses. Each generator is air cooled, rated at 30 volts DC, regulated to 28.5 volts, 300 amps. The generators are used as motors for engine starting, then become generators at the completion of the start cycle. Each generator system is operated independently, but power is distributed through systems that are in parallel except under fault conditions. The generators share loads equally (+10% of total load) during normal operation via an equalizer connection between the generator control units (GCU).

DC power from the engine-driven generators is distributed to two main DC buses (Figure 2-2). The two main DC buses are paralleled through two 225-amps current limiters connected to the battery bus. Generator power is routed to the hot battery bus through the battery relay and also to the emergency bus through the emergency relay. The battery and emergency relays are operated by the battery switch.

EXTERNAL POWER

An external power unit may be connected to the aircraft DC system through a receptacle in the fuselage below the left engine nacelle (Figure 2-3). External power is routed to the hot battery bus (Figure 2-4). The battery charges from the external power unit regardless of the battery switch position.

Before connecting an external power unit, the voltage of the unit should be regulated to 28.0

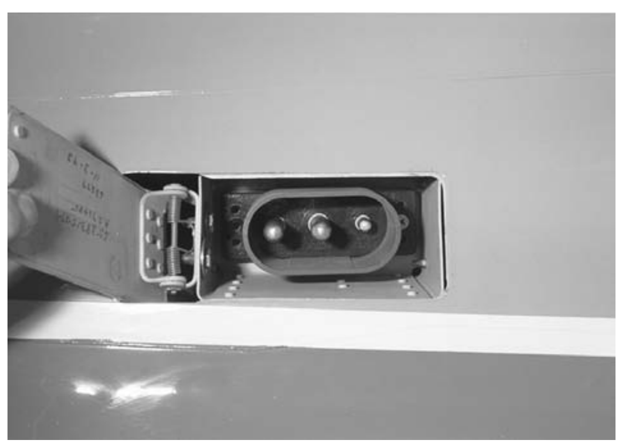


Figure 2-3. External Power Receptacle

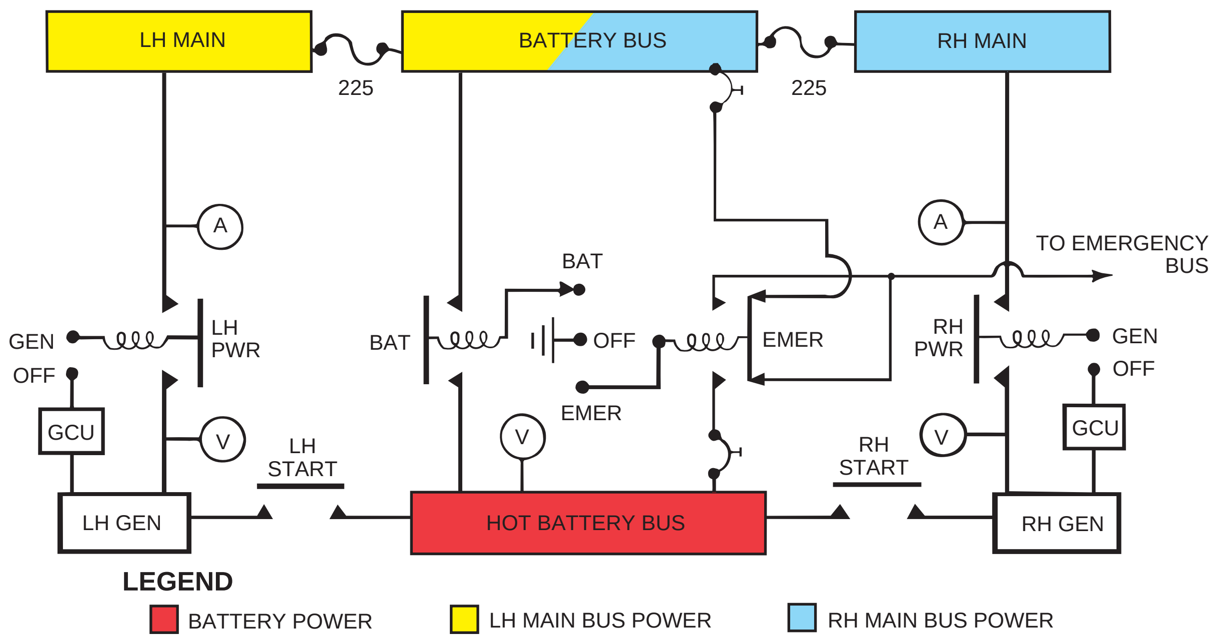


Figure 2-2. Generator Circuit—UNs 0260 and Subsequent

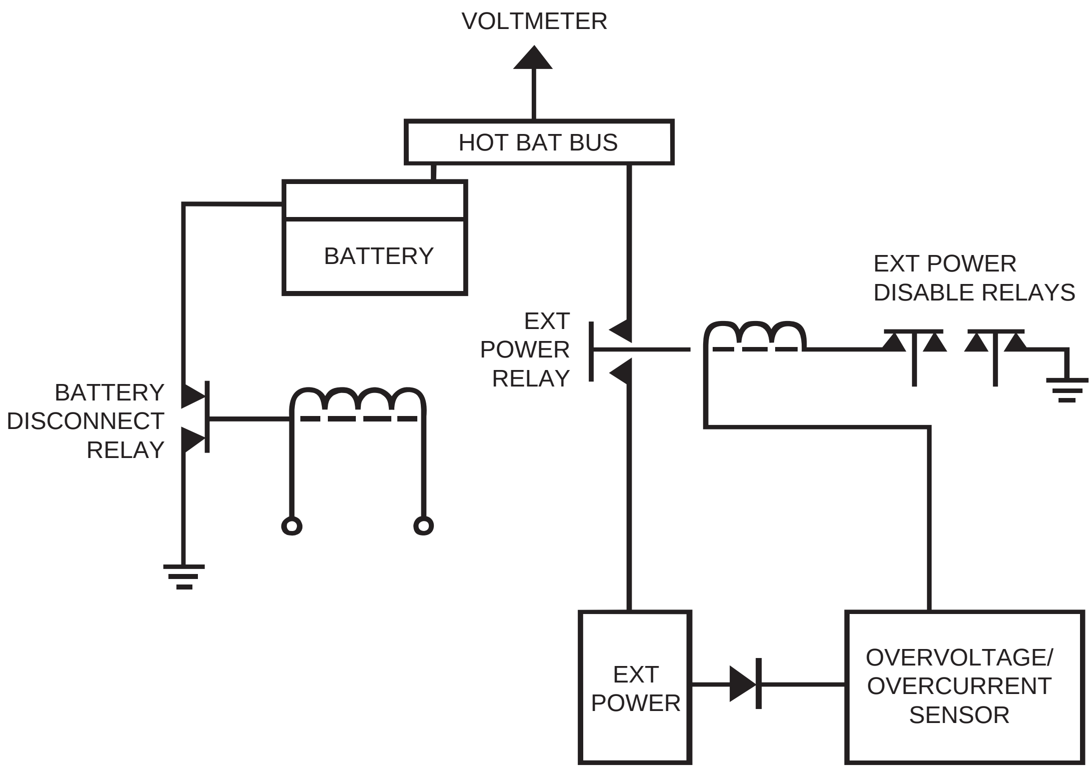


Figure 2-4. External Power Circuit

volts, and the amperage output should be between 800 and 1,000 amps.

Connecting the external power source energizes the external power relay, connecting the external power source to the hot battery bus. Placing the battery switch to the BATT position energizes the battery relay, allowing the DC external power to be connected to the battery bus, and the left and right main buses. The external power relay is deenergized to remove external power from the hot battery bus when either generator power relay is closed. This is to prevent the aircraft generators and the EPU from applying power to the aircraft buses simultaneously.

NOTE

Some external power units do not have reverse current protection, and, if the unit is turned off while connected to the aircraft, rapid discharge and damage to the battery can result. Always disconnect the EPU from the aircraft when not in use.

DISTRIBUTION

Direct current is distributed throughout the aircraft by nine buses (Figures 2-5, 2-6, and 2-7). in the main junction box in the tail cone compartment are two main DC buses, the battery bus, and the hot battery bus. In the cockpit, at the pilot CB panels, are two main extension buses, two crossover buses, and the emergency buses.

The two main DC buses are normally powered by the right and left generators and are tied together by the battery bus. They may also receive power from the battery or an external power unit.

The hot battery bus is always connected directly to the battery. It may receive power from an external power unit, and, during normal operation, it is powered from the generators.

The battery bus functions solely as a bus tie to connect the hot battery, the emergency, and the two main DC buses, tying the four parts into one integral system.

From each main DC bus in the tail cone, an extension bus provides distribution of power to components through controls and circuit breakers in the cockpit. The left and right main extension buses are behind the pilot and copilot CB panels, respectively (Figure 2-8).

In order to permit logical grouping of circuit breakers (i.e., left and right ignition), circuit connection is provided from the right or left main extension bus to the opposite circuit-breaker panel through the right and left crossover buses.

Emergency buses are on each CB panel.

Primary items that receive power directly from the hot battery bus are:

- Lights—Cabin entrance, nose baggage compartment, tail cone, and emergency exit
- Ignition, start only
- Voltmeter—Battery voltage (battery switch in BATT or EMER), left/right generator voltage regardless of battery switch position
- Emergency Bus (In BATT or EMER without generators)
- Emergency battery pack
- ELT

Emergency bus items are the following:

- COMM 1
- Audio panels No. 1 and No. 2
- NAV 1
- DG 1 and standby HSI
- Standby airspeed indicator/altimeter vibrator
- LH and RH N_1 indicators
- Standby pitot/static heat
- Cockpit floodlights
- Voltmeter

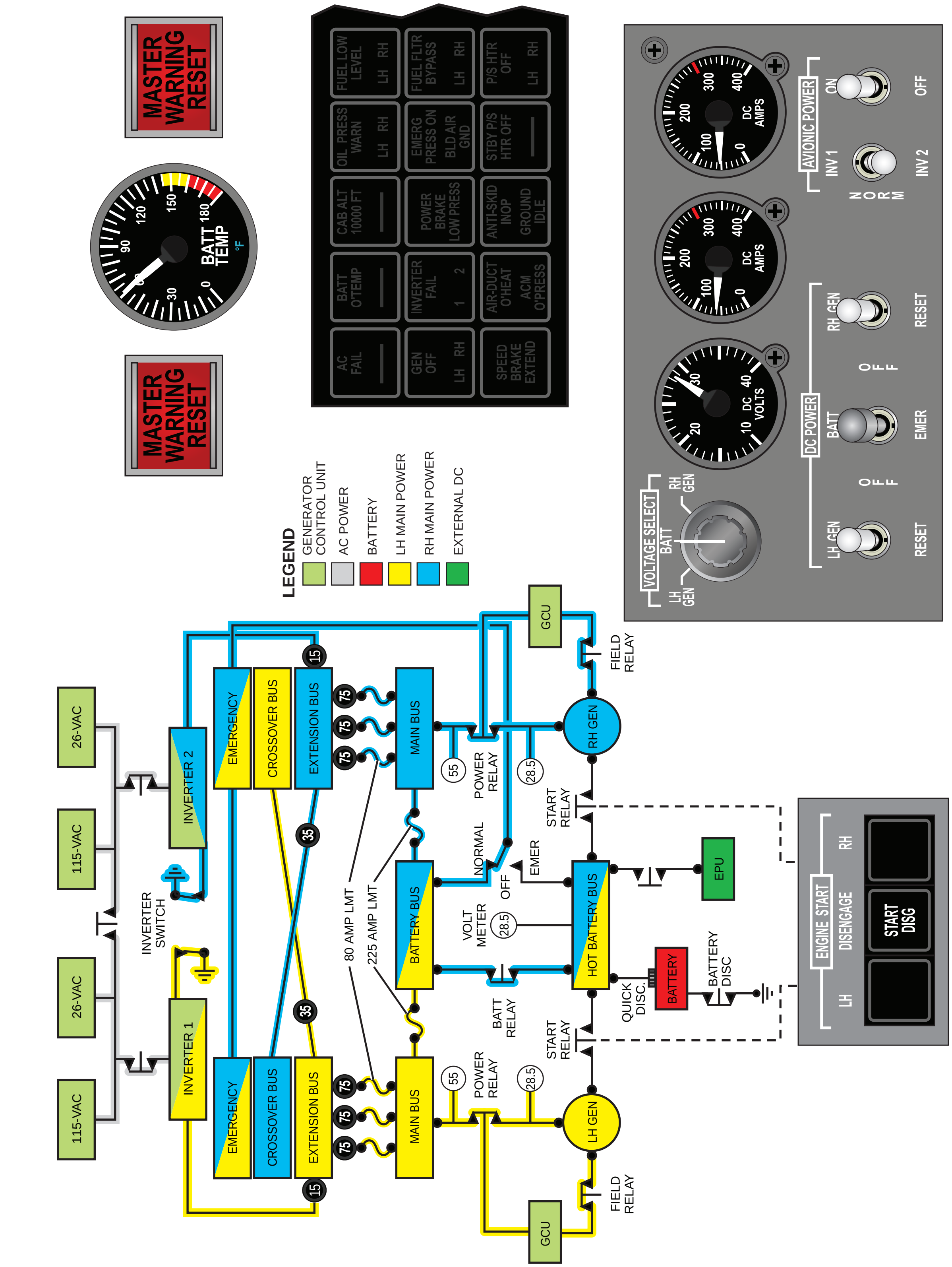


Figure 2-5. System Distribution

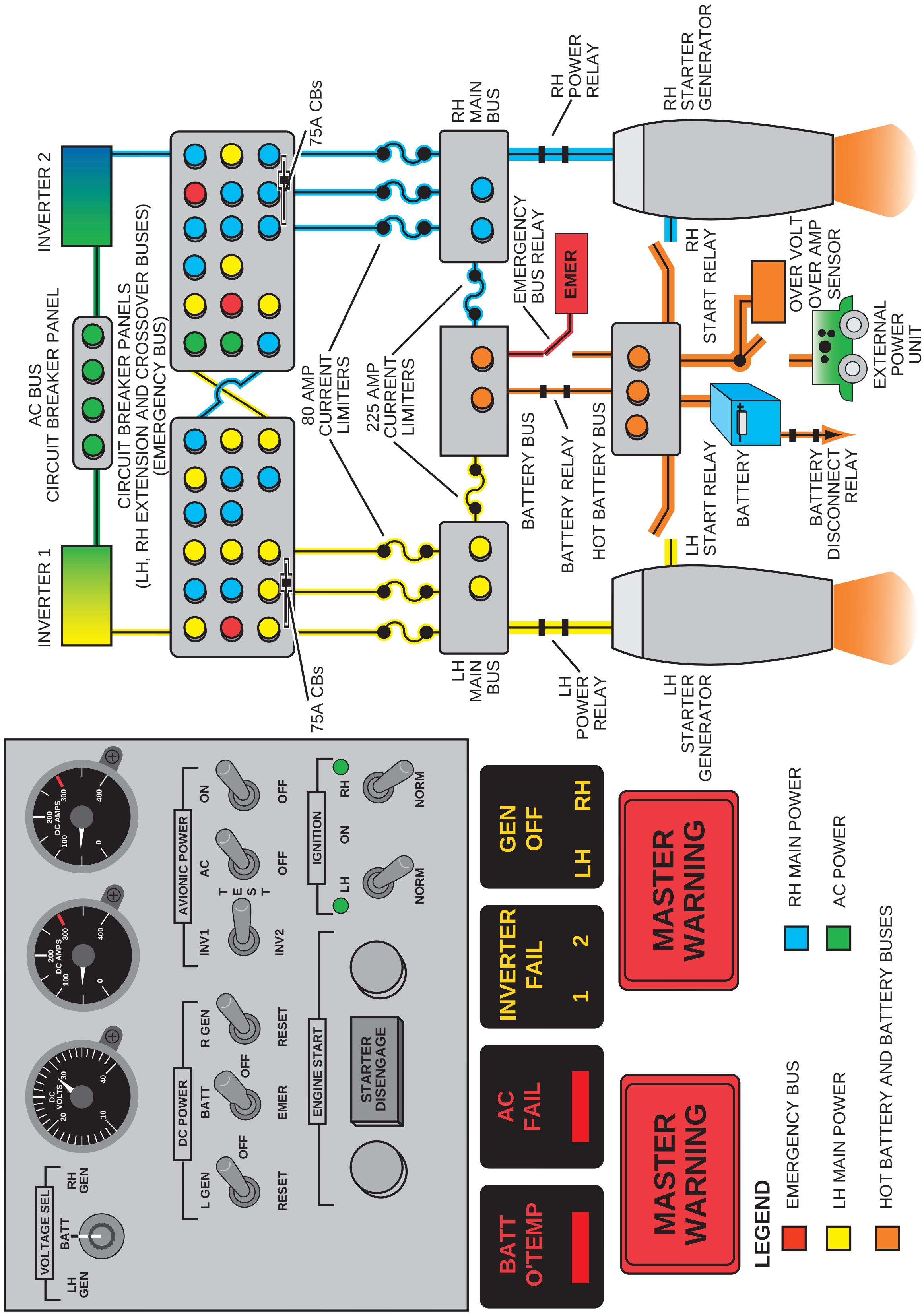


Figure 2-6. DC Electrical System Operation (UNs 0260-0292 and 0294-0306)

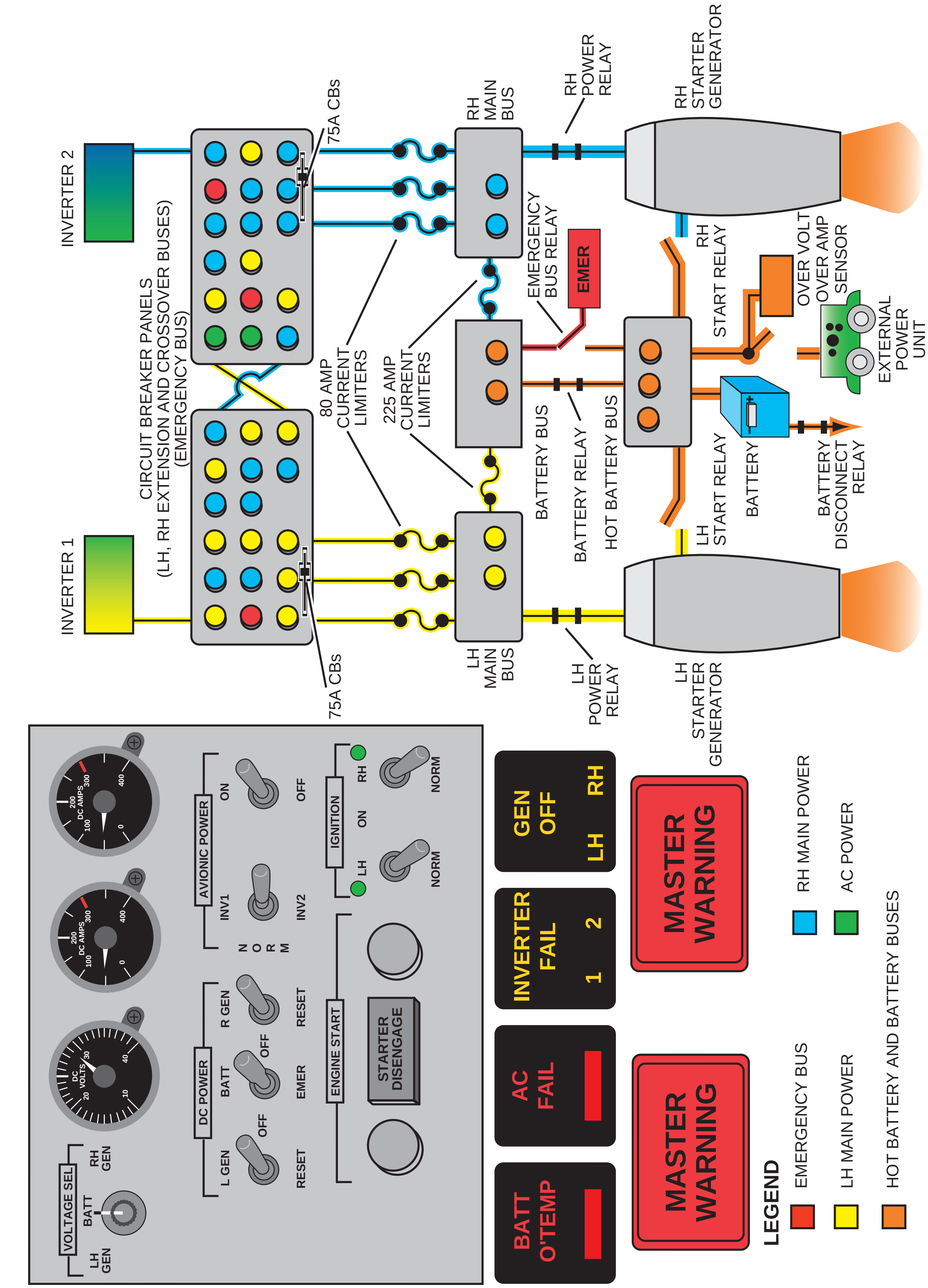
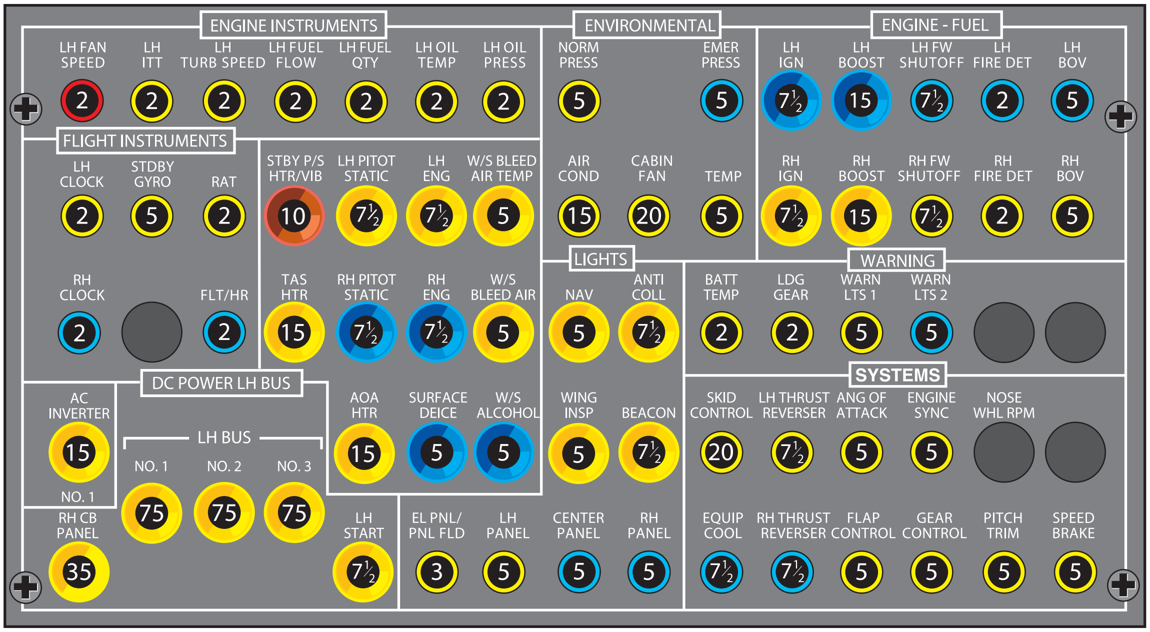
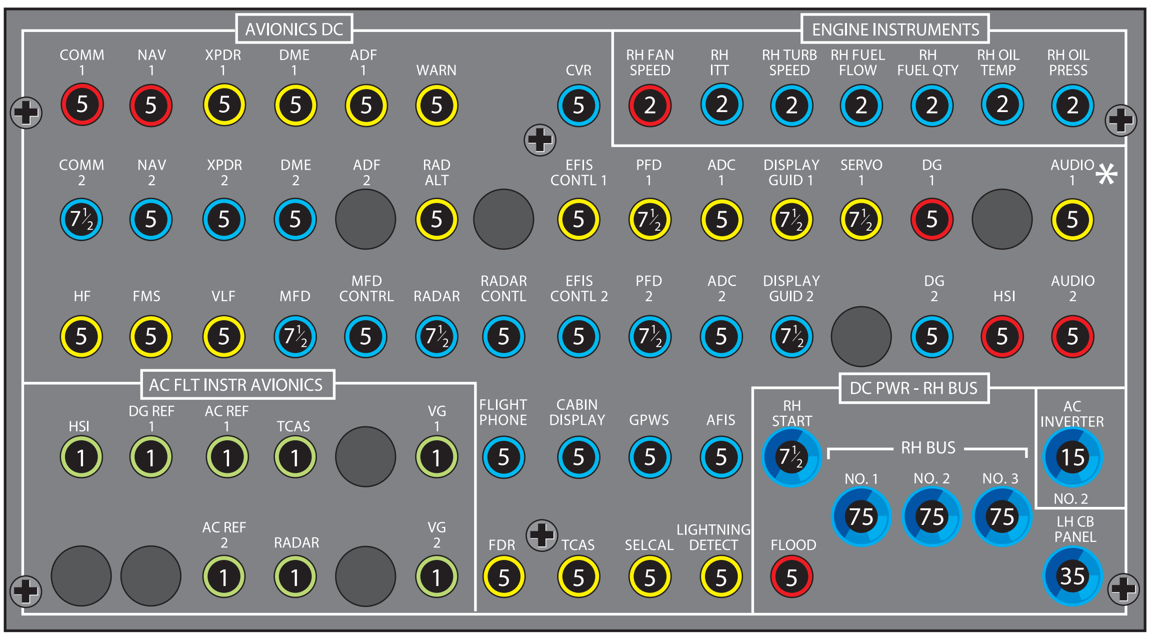


Figure 2-7. DC Electrical System Operation (UNs 0293, 0307, and Subsequent)



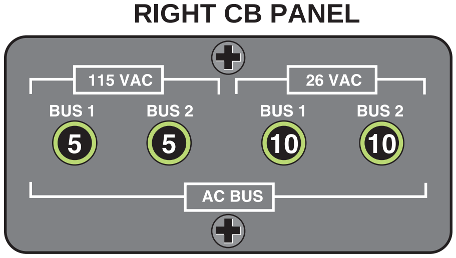
LEFT CB PANEL



RIGHT CB PANEL

LEGEND

- LEFT CROSSOVER BUS
- RIGHT MAIN EXTENSION BUS
- EMERGENCY BUS
- AC BUS



* AUDIO 1 SWITCHES TO EMER BUS WHEN BATT SWITCH IS IN EMER.

NOTE:
THE AC BUS SUBPANEL IS NOT INSTALLED IN UNs 0293, 0307 AND ON, WITH MANUAL INVERTER SWITCHING.

Figure 2-8. CB Panels—UNs 0260 and Subsequent

In addition, the standby gyro lead-acid battery provides 30-minute power to the standby gyro and provides back lighting for:

- Standby gyro
- N_1/ITT indicators
- Standby HSI
- Standby airspeed/altimeter

CONTROL

Control of the DC power system is maintained with a battery switch and two generator switches (Figure 2-9). The battery switch has three positions: BATT, OFF, and EMER. With the switch in the OFF position, the hot battery bus is isolated from all other buses in the system and the emergency buses are connected to the battery bus. The battery switch in the BATT position closes the battery relay completing circuits to the battery bus. In the EMER position, only the emergency relay is energized, connecting the emergency bus to the hot battery bus. The two buses are powered by the battery or by external power. When external power is not applied to the aircraft and the generators are on the line, placing the battery switch in EMER or OFF isolates the battery from any charging source without the loss of power to any buses.

Figure 2-9. DC Electrical Controls

The generator switches are also three-position switches: GEN, OFF, and RESET. Placing the switch to GEN allows the generator control unit (GCU) to close the power relay and connects the generator to its main DC bus. With the switch in the OFF position, the power relay can not close, and the generator can not assume any load. Placing the switch in the spring-loaded RESET position should close the generator field relay if it has opened.

On the center panel are two engine start buttons. When depressed, they activate a circuit to close the associated start relay and allow current to flow from the hot battery bus directly to the starter-generator. A starter disengage button, between the starter buttons, can be utilized to open the start circuit if manual termination of the start sequence is desired.

MONITORING

The DC electrical system is monitored by a voltmeter, two ammeters, two GEN OFF LH/RH annunciator warning lights, a BATT O'TEMP warning light, and a battery temperature gauge (Figure 2-10).

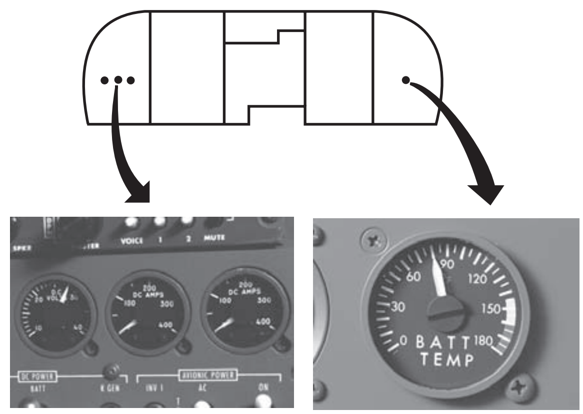


Figure 2-10. Electrical Indicators

When illuminated, an amber GEN OFF LH/RH annunciator light indicates an open power relay. If both annunciator lights are illuminated, the MASTER WARNING lights also flash.

A voltmeter selector switch permits monitoring of voltage on the hot battery bus or from a point between each generator and its power relay. The selector is spring-loaded to the BATT position, in which hot battery bus voltage is

indicated. The voltmeter indicates the highest voltage of the source connected to the point being monitored. When one generator is on the line and the voltmeter selector is in either BATT or the corresponding generator position, the voltmeter reads the generator voltage. If the voltmeter selector switch is moved to read a generator output (generator not connected to the buses), it indicates only the voltage output of the selected generator. The gauge can not read hot battery bus voltage when the battery switch is in OFF.

The ammeters read the current flow from their individual generators to the main DC bus and, during normal operation, their indication should be approximately equal (±10% of total load). Amperage in the circuit between the starter-generator and the hot battery bus is not reflected on the ammeter.

A temperature sensor in the battery initiates a steady BATT O'TEMP light on the annunciator panel (with the flashing MASTER WARNING lights) when battery temperature rises to 145°F. If the temperature continues to rise to 160°F, the BATT O'TEMP light flashes (with flashing MASTER WARNING lights). A temperature gauge, which receives input from a separate sensor in the battery, reads temperature from 0°F to 180°F.

In each engine start button is a light that, when illuminated, indicates closure of the start relay. The light inside the STARTER DISENGAGE button has no significance for operation. It is activated on when the panel lights are turned on for night operations.

PROTECTION

Two generator control units (GCUs) regulate, protect, and parallel the generators. Each unit controls a power relay which connects the generator to its main DC bus. The GCU permits the relay to close when the cockpit generator switch is GEN and the generator output equals (within .3 volts) or exceeds system voltage. A field relay, in the generator control unit, allows or prevents field excitation within the generator. When an internal feeder fault (short circuit) or an overvoltage is sensed, the field relay opens. The field relay also opens when the engine fire switch is activated. A reverse current (10% of total load) or undervoltage opens the power relay.

The circuits between each main DC bus and its extension bus are protected by three 75-amps circuit breakers in parallel on the corresponding cockpit CB panel. A 35-amps circuit breaker on each extension bus provides protection between the extension bus and the crossover bus on the opposite CB panel. Various other circuit breakers on the main buses in the tail cone protect against overload.

Between each main DC bus and the battery bus, a 225-amps current limiter (fuse) protects the system against overloading. Loss of either current limiter causes the system to split and become two independent systems (right and left). When one generator power relay is closed, it is necessary to protect the 225-amps current limiter from the high amperage required to start the opposite engine. To provide this protection a battery disable relay causes the battery relay to open the circuit between the battery bus and the hot battery bus during the engine start sequence.

When an external power unit is utilized for engine start, the battery disconnect relay opens when the start is initiated and removes the battery ground. This ensures that the battery is not utilized for starting power, and, consequently, battery start limitations do not apply.

Should an external power unit output be excessive, an overvoltage/overcurrent sensor opens the external power relay and breaks the circuit to the hot battery bus. External power disable relays also disconnect the external power unit from the hot battery bus whenever a power relay closes, bringing a generator on the line. There is no reverse current protection between the hot battery bus and the EPU.

CAUTION

Some external power units do not have reverse current protection. If the unit is turned off while connected to the aircraft, rapid discharge and damage to the battery can result. Always disconnect the EPU from the aircraft when not in use.

OPERATION

Normal

During the interior preflight, the generator switches should be placed to GEN if a battery start is intended or OFF if external power is to be used. The battery switch should be placed to BATT and the voltmeter checked for 24 volts minimum.

After checking lights and pitot heat, the battery switch should be turned to OFF. During the exterior preflight, the battery should be visually checked for signs of deterioration or corrosion. External power should not be connected until these checks are complete.

Before starting the engines, the generator switches should be rechecked for proper position and battery voltage verified. The battery switch must be in the BATT position in order to allow power from the main DC extension bus to close the start relay when the start button is depressed. Depressing the start button also activates the electric fuel boost pump, arms the ignition, and activates the engine instrument floodlight.

Closure of the start relay, indicated by illumination of the light in the start button, connects hot battery bus power to the starter for engine rotation. At between 8 and 10 % turbine rpm (N_2), the throttle should be brought from cutoff to idle. Fuel flow commences by increasing LCD display, and ignition is activated by a throttle switch. A green light indicates current to both exciter boxes. Within ten seconds, combustion should occur as evidenced by rising ITT. As the engine accelerates and reaches approximately 38% (N_2), the start sequence automatically terminates. The electric boost pump and ignition deactivate, the start relay opens, and the engine instrument floodlight goes out. A speed sensing switch on the starter-generator terminates the start sequence.

The starter-generator reverts to generator operation, and the GCU allows it online after start termination and when the generator output equals or exceeds system voltage.

For a subsequent engine start on the ground, the operating generator assists the battery in providing current to the starter. The operating engine must be stabilized at 52% to 53% N_2. As soon as the second start button is pressed, the battery disable relay opens disconnecting the hot battery bus from the battery bus. This is done to protect the 225-amps current limiter on the side of the operating engine. At the same time the respective electric boost pump is activated, the ignition is armed, the engine instrument flood light illuminates, and both start relays close. Both start button lights should be illuminated. At approximately 38% N_2, the start sequence should automatically be terminated.

The generator assist capability is disabled by the squat switch when it is in the airborne position. If an inflight restart is accomplished utilizing the start button, it is a full battery start. Only the associated start relay closes, the boost pump on that side activates, the ignition circuit to that engine arms, and the engine instrument floodlight illuminates. The only difference between this start in flight and one accomplished on the ground, with one generator on the line, is that the start relay on the same side as the operating generator does not close. This isolation of the start circuit, from the operating generator, and buses in flight, is required by certification regulations. The protection circuit for the 225-amps limiter is the same as described above.

An external power unit may also be utilized for engine starts. However, prior to use the unit should be checked for voltage regulation (28.0 volts) and an availability of 800 to 1,000 amps.

When external power starts are planned, the generator switches should remain in the OFF position until the external power has been removed from the aircraft. Otherwise, when the first generator comes on line, the external power is automatically disconnected from the hot battery bus, and the second engine start becomes a generator-assisted battery start.

Abnormal

Battery overheat can result from an excessive amount and rate of charge, discharge, or internal battery damage. The greatest damage which can result from a battery overheat lies in the possibility of runaway heating, in which internal failures cause the heat to continue building out of control.

Battery overheat is indicated initially by a steady BATT O'TEMP light on the annunciator panel (145° F). This red light triggers the MASTER WARNING lights. Continued rising temperature (160° F) causes the BATT O'TEMP light to flash and reilluminate the MASTER WARNING lights. The battery temperature gauge should verify the temperatures. Whenever an overheat condition exists, the battery switch should be placed in the EMER position to open the battery relay, thus removing the battery from generator charging, and the emergency procedures checklist should be consulted. Monitoring the ammeters for a drop and the voltmeter for a minimum one-volt drop in thirty seconds to two minutes ensures that the battery relay has opened, isolating the hot battery and emergency buses from system charging.

If the speed-sensing switch fails to terminate a start sequence, the STARTER DISENGAGE button can be utilized to terminate the start. Its use causes no damage to any component in the system. The GCU only permits the generator on the line after the start sequence has been terminated.

Monitoring the ammeters may provide the pilot indication of impending generator problems. Amperage readings may indicate unparalleled operation if they are different by more than 10% of the total load. When a GEN OFF LH/RH light illuminates on the annunciator panel, a check of the voltmeter indicates whether the field relay or only the power relay has opened. An open field relay could be caused by a feeder fault (short circuit), overvoltage, or by actuation of the engine fire switch. A tripped field relay is indicated by near zero voltage; it can possibly be reset with the generator switch. An undervoltage or reverse current causes the generator control unit to open the power relay. If normal voltage is observed on the voltmeter when the affected generator is selected with the voltage selector switch, generator reset is not probable.

Ultra GCUs have 4 BITE lights (Built-In-Test-Equipment) for fault detection. GCU fault lights may indicate a GCU fault, overvoltage, a ground fault, or a system problem. It self-tests all LEDs at power-up. Flashing LEDs can be extinguished by resetting the appropriate generator switch 3 times within three seconds if no faults exist.

Should it be necessary to disable the circuit breaker panel at the pilot position, it can be accomplished by pulling the three 75-amps circuit breakers labeled "LH BUS," the LH FAN SPEED breaker, the STBY P/S HTR/VIB breaker, and, on the copilot CB panel, the 35-amps breaker labeled "LH CB PANEL." The first set of breakers disconnects the left main extension bus. The second set disables the emergency bus equipment on the pilot panel. The sixth circuit breaker disconnects the crossover bus from the right main bus extension. The reverse procedure is necessary to disable the copilot CB panel, and, because most of the emergency bus is behind the copilot panel, eight component circuit breakers must also be pulled. They are COMM 1, NAV 1, DG 1, FLOOD, STBY HSI, RH FAN SPEED, and AUDIO 1 and AUDIO 2.

NOTE

When the three 75-amps main bus breakers are pulled, the crossover bus to the opposite CB panel is also disabled.

Failure of a 225-amps current limiter after start can be detected during the generator check accomplished after engine start. When one generator switch is placed to OFF, the other generator should pick up the entire system load as indicated on the ammeter. If this does not occur, a failed current limiter could be the cause. If this is the case, when the generator on the side with the failed limiter is selected to OFF, the buses on that side lose power. This is most easily detected by observing the engine instruments and a steady MASTER WARNING light on the side of the failed current limiter. The aircraft should not be flown in this condition. If the current limiter has failed prior to start, the engine start circuit on the side with the failed limiter is not powered (because of the loss of DC power to the extension bus), thus preventing that engine from being started until the limiter is replaced.

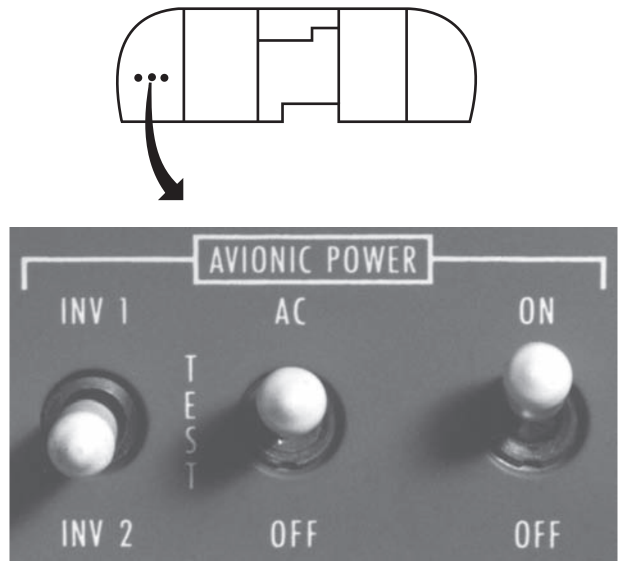


Figure 2-11. AC Controls—UNs 0260–0292 and 0294–0306

AC POWER

The alternating current system consists of two 375 volt-amps inverters powering two 115-VAC buses and two 26-VAC buses. Each set (a 115-volt and a 26-volt bus) is normally powered by its corresponding inverter; however, either inverter can provide sufficient power to supply both sets of buses, if necessary

AUTOMATICALLY SWITCHED INVERTERS

UNs 0260–0292 and 0294–0306

Control

A two-position switch activates both inverters when moved to the AC position (Figure 2-11). Should an inverter fail, automatic switching connects the remaining inverter to the buses of the failed inverter.

Monitor and Test

The AC system is monitored by a red AC FAIL annunciator light (which triggers the MASTER WARNING lights) and two amber INVERTER FAIL 1/2 lights. An inverter failure should illuminate the appropriate INVERTER FAIL light, the AC FAIL light, and the MASTER WARNING lights. Resetting the MASTER WARNING light resets the AC FAIL light as well, but leaves the INVERTER FAIL light illuminated. When power is lost to any or all of the AC buses, only the AC FAIL light illuminates, along with the MASTER WARNING lights. In this condition, resetting the MASTER WARNING does not extinguish the AC FAIL light. A test switch (see Figure 2-10) provides simulation of inverter failure and corresponding indications. When the switch is positioned to INV 1, the No. 1 inverter is disabled, causing illumination of the associated INVERTER FAIL 1 light, AC FAIL light, and the MASTER WARNING lights. Releasing the switch to the center position repowers the associated inverter. When the switch is positioned to INV 2, the sequence is reversed for the No. 2 inverter system.

Operation

Normal

The inverters should be activated during accomplishment of the Before Taxiing Checklist, and they should be tested later during the Before Taxiing Checklist after gyro spin up. The inverters should be turned off prior to engine shutdown or during any ground starter engagement.

Abnormal

In the event of a failure in the AC system, check the AC inverter, AC FLT INSTR AVIONICS circuit breakers (see Figure 2-8), and the AC BUS circuit breakers then comply with the appropriate checklist in the "Emergency Procedures" section of the *Airplane Flight Manual (AFM)*(Figure 2-12). If both inverters fail, the battery switch must be placed in EMER and this provides AC power from the static inverter in DG1 to power the standby HSI compass system and NAV 1.

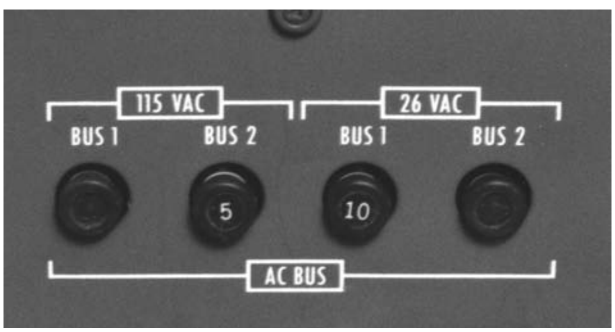


Figure 2-12. AC Circuit-Breaker Subpanel

MANUALLY SWITCHED INVERTERS

UNs 0293, 0307 and Subsequent

Control

Two avionics power switches, one labeled INV 1-NORM-INV 2 and one labeled ON-OFF are on the pilot switch panel (Figure 2-13). The

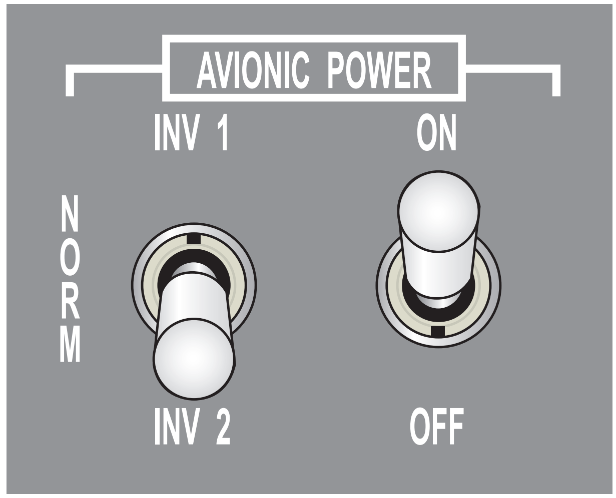


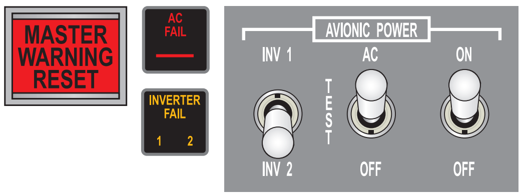
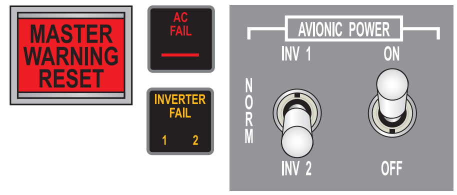
Figure 2-13. AC Controls—UNs 0293, 0307, and Subsequent

two position ON–OFF switch activates BOTH inverters when moved to the ON position. Should an inverter fail, placing the INV 1–NORM–INV 2 switch to the active inverter position, i.e., INV 1 or INV 2 restores AC power to all four AC buses (Table 2-1).

Monitor and Test

The AC system is monitored by a red AC FAIL annunciator light (which triggers the MASTER WARNING lights) and two amber INVERTER FAIL 1/2 lights. An inverter failure should illuminate the appropriate INVERTER FAIL light, the AC FAIL light, and the MASTER WARNING lights. Switching the left switch from NORM to the operating inverter restores AC power to the AC buses that were lost due to the inverter failure. Resetting the MASTER WARNING lights resets the AC FAIL light but leave the respective INVERTER FAIL light illuminated. When power is lost to any or all of the AC buses, only the AC FAIL light illuminates, along with the MASTER WARNING lights. In this condition, resetting the MASTER WARNING does not extinguish the AC FAIL light. The system may be tested by placing the left switch from NORM to INV 1 which disables inverter No. 2 illuminating INVERTER FAIL 2 annunciator. This action should cause the AC FAIL light to illuminate and the MAS-

Table 2-1. AC/AVIONICS POWER

<table>
<tr><th>UNs 0260 - 0292 and 0294 - 0306</th><th>UNs 0293, 0307 and SUBSEQUENT</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>AC POWER SPLIT BUS SYSTEM
WITH AUTOMATIC SWITCHING</td><td>AC POWER SPLIT BUS SYSTEM
WITH MANUAL SWITCHING</td></tr>
<tr><td>In NORM, Inverter 1 powers the #1 115 and #1 26 VAC buses. Inverter 2 powers the #2 115 and #2 26 VAC buses.

If either Inverter fails, the system will automatically switch all buses to the operating Inverter. Reset the MASTER WARNING and check the failed Inverter circuit breaker (DC source breaker). The following items are powered by the AC bus circuit breakers:

<table>
<tr><th>115 VAC</th><th>115 VAC</th><th>26 VAC</th><th>26 VAC</th></tr>
<tr><td>BUS 1
VG 1</td><td>BUS 2
VG 2</td><td>BUS 1
DG 1
YAW RATE
GYRO</td><td>BUS 2
DG 2
RADAR
TCAS (OPT)</td></tr>
</table>

NOTE:
IF ANY OF THE FOUR AC BUSES ARE LOST, NEITHER THE AUTOPILOT NOR FLIGHT DIRECTOR CAN BE USED.

NOTE:
HAS AC BUS SUBPANEL WITH 4 CIRCUIT BREAKERS.</td>
<td>In NORM, Inverter 1 powers the #1 115 and #1 26 VAC buses. Inverter 2 powers the #2 115 and #2 26 VAC buses.

If Inverter 1 fails, move the inverter switch to the INV 2 position. This turns off power to Inverter 1. Inverter 2 will supply power to all four AC buses.

If Inverter 2 fails, move the inverter switch to the INV 1 position. This turns off power to Inverter 2. Inverter 1 will supply power to all four AC buses.

Manually switching to the good inverter will normally power all four AC buses from the selected inverter. If the system fails to switch, return the inverter switch to the NORM position. The following items are powered by the respective Inverters.

<table>
<tr><th>INVERTER 1</th><th>INVERTER 2</th></tr>
<tr><td>YAW RATE GYRO
DG #1
VG #1</td><td>RADAR
DG #2
VG #2
TCAS</td></tr>
</table>

NOTE:
IF ANY OF THE FOUR AC BUSES ARE LOST, NEITHER THE AUTOPILOT NOR FLIGHT DIRECTOR CAN BE USED.
NOTE:
NO AC BUS SUBPANEL.</td></tr>
</table>

TER WARNING lights to flash. Resetting the MASTER WARNING lights also resets the AC FAIL light off. The test sequence may be repeated for the opposite inverter by selecting INV 2 position.

Operation

Normal

The inverters should be activated during the accomplishment of the Before Taxiing Checklist, and they should be tested later during the Before Taxiing Checklist after gyro spin up. The inverters should be turned off prior to engine shutdown or any ground starter engagement.

Abnormal

In the event of a failure in the AC system, check the AC inverter, AC FLT INSTR AVIONICS circuit breakers (see Figure 2-8), and comply with the appropriate checklist in the "Emergency Procedures" section of the Flight Manual. If both inverters fail, the battery switch must be placed in EMER. This action provides AC power from the static inverter in the DG 1 to power the standby HSI compass system.

LIMITATIONS

The battery and starter cycle limitations are shown in Table 2-2.

Continuous ground operation of the generator above 125 amps at 46% N_2 or above 225 amps at 52% N_2 is prohibited.

If the BATT O'TEMP light illuminates during ground operation, do not take off until after the proper maintenance procedures have been accomplished.

Table 2-2. BATTERY AND STARTER CYCLE LIMITATIONS

TYPE LIMIT	LIMITATION
Starter with external power unit or generator-assisted starts as the starter power source	Two engine starts per 30 minutes. Two cycles of operation with a 90-second rest period between cycles is permitted.
Starter with battery as a power source	Three engine starts per 30 minutes. Three cycles of operation with a 90-second rest period between cycles is permitted.
Battery	Three engine starts per hour. See notes 2 and 3.

NOTES:

1. If battery limitation is exceeded, a deep cycle, including a capacity check, must be accomplished to detect possible cell damage.
2. Three generator-assisted starts are equal to one battery start.
3. If an external power unit is used for start, no battery cycle is counted.
4. Use of an external power source with voltage in excess of 28 VDC or current in excess of 1,000 amps may damage the starter.

QUESTIONS

1. A good battery should supply power to the hot battery bus and the emergency bus for approximately:
   A. 2 hours
   B. 1 hour
   C. 30 minutes
   D. 10 minutes

2. The battery bus serves as:
   A. Power-off DC source
   B. Emergency power source
   C. Extension bus
   D. Bus tie

3. In flight, with the generators on the line, the battery is isolated from any charging source when the battery switch is in:
   A. OFF
   B. BATT
   C. EMER
   D. Both A and C

4. If manual termination of a start sequence is desired, the switch to press is:
   A. ENGINE START
   B. STARTER DISENGAGE
   C. LH START
   D. RH START

5. The voltage read on the voltmeter with the selector switch in BATT is sensed from the:
   A. Battery bus
   B. Left main bus
   C. Hot battery bus
   D. Right main bus

6. If the generators are not operating, the voltmeter reads battery voltage when the battery switch is in:
   A. OFF
   B. BATT
   C. EMER
   D. Both B and C

7. The light in each engine start button illuminates to indicate:
   A. Starting is complete.
   B. Opening of the start relay
   C. Closing of the start relay
   D. Generator disconnect

8. The generator field relay opens when:
   A. Internal feeder fault is sensed.
   B. Overvoltage condition is sensed.
   C. Engine fire switch is activated.
   D. All of the above

9. If a battery start is intended, the generator switches should be placed to:
   A. OFF
   B. GEN
   C. RESET
   D. ON

10. When the inverter/AVIONICS POWER switches are positioned to AC and ON, or NORM and ON, normally:
    A. No. 1 inverter supplies all AC buses.
    B. Both inverters are paralleled to supply all AC buses.
    C. No. 2 inverter produces only 26-VAC power.
    D. Each inverter supplies its own AC buses.

11. Illumination of the AC FAIL annunciator light and the MASTER WARNING lights indicates:
    A. Failure of No. 1 inverter
    B. Failure of No. 2 inverter
    C. Failure of both inverters
    D. Any of the above

12. Positioning the inverter test switch to the INV 1 position disables (UNs 0260-0292 and 0294-0306):
    A. No. 1 inverter
    B. No. 2 inverter
    C. The No. 1 inverter and both of its buses
    D. Neither inverter

13. With the battery as the only source of power and the battery switch in the OFF position, the bus(es) powered are:
    A. Battery bus, hot battery bus
    B. Emergency buses, battery bus
    C. Hot battery bus
    D. Emergency buses, battery bus, hot battery bus

14. With the battery as the only source of power and the battery switch in the EMER position, the following bus(es) are powered:
    A. Battery bus, hot battery bus
    B. Emergency buses, hot battery bus
    C. Hot battery bus
    D. Emergency buses, battery bus, hot battery bus

15. With the battery as the only source of power and the battery switch in the BATT position, the following condition exists:
    A. The battery, emergency, and hot battery buses only receive power.
    B. All buses are powered except the emergency buses.
    C. LH and RH main DC buses only are powered.
    D. All DC buses are powered.

16. With only the hot battery and emergency buses powered, the following item is inoperative:
    A. Nav 2
    B. Engine instrument floodlight, emergency exit lights
    C. Pilot standby HSI, Com 1
    D. Nav 1

17. The correct statement is:
    A. With external power connected and the battery switch in OFF, all DC buses are powered from the external power unit.
    B. The battery switch must be out of the OFF position before the voltmeter indicates the voltage of the hot battery bus.
    C. With external power connected and the battery switch in OFF, all DC buses are powered from the external unit except for the battery itself.
    D. The battery continues to charge with the generators on the line regardless of the battery switch position.

18. Regarding the engine starting sequence (battery start on the ground):
    A. It is normally terminated by the pilot with the STARTER DISENGAGE button.
    B. The boost pumps and ignition switches must both be in the ON position before the start button is depressed.
    C. A minimum of 50% N_2 is required on the operating engine prior to starting the second engine.
    D. It is terminated normally by the speed sensing switch on the starter-generator.

19. The incorrect statement is:

A. The illumination of the STARTER DISENGAGE button is a function of the panel lights master switch.
B. The generator switches are placed in the OFF position for an EPU start.
C. The battery switch is placed in the OFF position prior to an EPU start.
D. A failed LH 225-amps current limiter prevents starting of the left engine.

20. Regarding a generator-assist start:

A. It is necessary to observe a drop in amperage to below 150 before depressing the second start button (to protect the 225-amps current limiter).
B. The operating generator switch must be placed to OFF before the start button is depressed.
C. A maximum of 49% N_2 rpm is set on the operating engine.
D. 52% to 53% N_2 is set on the operating engine.

21. Placing the battery switch in the EMER position with the generators on line:

A. Does not cause the immediate loss of any buses
B. Causes loss of power to the emergency bus since the generators are on the line
C. Can still provide charging power to the battery
D. Should result in the voltage indication remaining at 28.5 volts

22. The correct statement regarding the GEN OFF LH/RH annunciator light is:

A. Illumination of one light triggers the MASTER WARNING lights.
B. The light illuminates whenever the power relay is open.
C. Illumination of the light indicates that both the power and field relays have opened.
D. It indicates that the generator is still in its starter mode.

23. Ignition:

A. Occurs immediately when the start button is depressed
B. Is initiated automatically by the speed sensing switch at 8 to 10% N_2
C. Occurs when the throttle is brought to idle
D. Is terminated by the fuel control step modulator when it senses ITT above 300°C

24. The BATT O'TEMP light illuminates steady but:

A. Extinguishes if the battery cools down
B. Flashes as the battery is cooling down
C. Therefore the battery switch should be position to OFF (all buses continue to receive power)
D. The MASTER WARNING lights do not illuminate until the BATT O'TEMP light begins to flash

25. With the battery switch in EMER in flight (both generators on the line), the following indications are observed:

A. No noticeable change is observed.
B. The voltmeter drops to near zero as power is lost on all buses except the emergency and hot battery buses.
C. There is a loss of power to all buses except the emergency and battery buses.
D. The voltmeter indicates approximately 25 volts.

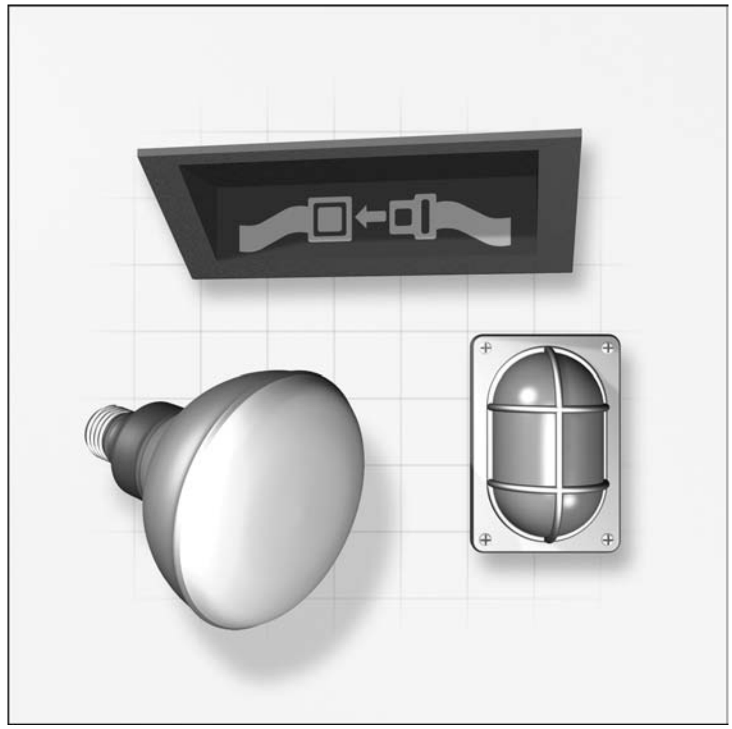
CHAPTER 3
LIGHTING

CONTENTS

Page

ILLUSTRATIONS

CHAPTER 3
LIGHTING



INTRODUCTION

Lighting on the Citation V Ultra aircraft is used to illuminate the cockpit area and all flight instruments. The majority of the instruments are internally lighted. For general illumination, floodlights are used and a map light is conveniently located for both the pilot and copilot positions. Standard passenger advisory lights are available for the cabin area, and emergency lights are available to illuminate the exits in the event of an emergency. Exterior lighting consists of navigation, anticollision, landing, taxi, wing inspection, and rotating beacon lights, and optional tail floodlights.

GENERAL

Aircraft lighting is divided into interior and exterior lighting. Interior lighting is further divided into cockpit, cabin, and emergency lighting. Cockpit lighting consists of instrument panel lights, floodlights, and map lights.

Cabin lighting consists of indirect fluorescent lights, passenger reading lights, two floodlights illuminating the main cabin door and emergency exit areas, an aft compartment light, and lighted signs.

INTERIOR LIGHTING

Interior lighting is provided for the cockpit, cabin, tail cone, and forward baggage areas. Instruments are internally lighted. Switch functions are designated by electroluminescent panels. All lights except the overhead and instrument floodlights are controlled by a master switch and are adjusted by rheostats (Figure 3-1). The rheostats has a LEFT, CENTER, RIGHT, and EL position. The LEFT rheostat controls the intensity of the lighting of the instruments on the pilot panel. The inner knob of the CENTER rheostat controls intensity of the amber LED lights in the COMM, NAV, ATC, ADF, DME, and optional HF avionics heads. Light intensity lags knob rotation but quickly catches up when increasing or decreasing intensity. If EMER is selected, on the battery switch (without generators), the COMM 1 and NAV 1 avionics LED lights go dim for one to two seconds, then are fixed at full bright. The outer rheostat of the CENTER light knob controls all other instrument lighting on the center instrument panel. The RIGHT rheostat controls instrument lighting on the copilot panel. The rheostat EL position controls all electroluminescent lighting. Clockwise rotation increases light intensity. Turning the PANEL LIGHT CONTROL master switch to ON dims the annunciator panel, ignition, and landing gear lights, illuminates the STARTER DISENGAGE button, and powers the control rheostats. The LEFT, CENTER, RIGHT, and EL knobs are deenergized with the loss of main DC or if the PANEL LIGHT CONTROL master switch is OFF. Two overhead floodlights and the engine instrument floodlight under the engine fire tray, provide additional normal lighting from main DC power or emergency cockpit lighting from the emergency bus and intensity is controlled by the FLOOD LTS rheostat (on the EMER BUS) to the left of the PANEL LIGHT master switch.

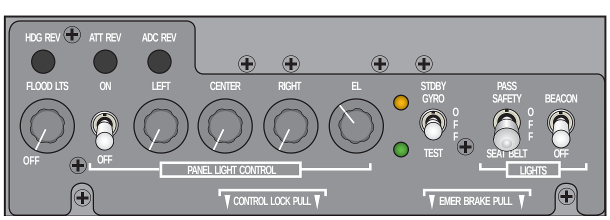


Figure 3-1. Interior Lighting Controls

COCKPIT LIGHTING

Cockpit Floodlights

Two cockpit floodlights are overhead, near the center of the flight compartment, provide cockpit lighting and emergency lighting for the instrument panel. Control is accomplished with the FLOOD LTS rheostat.

An engine instrument floodlight is under the fire warning panel on the glareshield. The light operates when either engine is in the start cycle or when the FLOOD LTS switch is turned on. Cockpit floodlight power is supplied by the emergency bus through the FLOOD circuit breaker on the copilot CB panel.

Map Lights

Map lights are on the left and right forward overhead panel (Figure 3-2). Their intensity is controlled by rheostats on the forward side of the left and right side consoles.

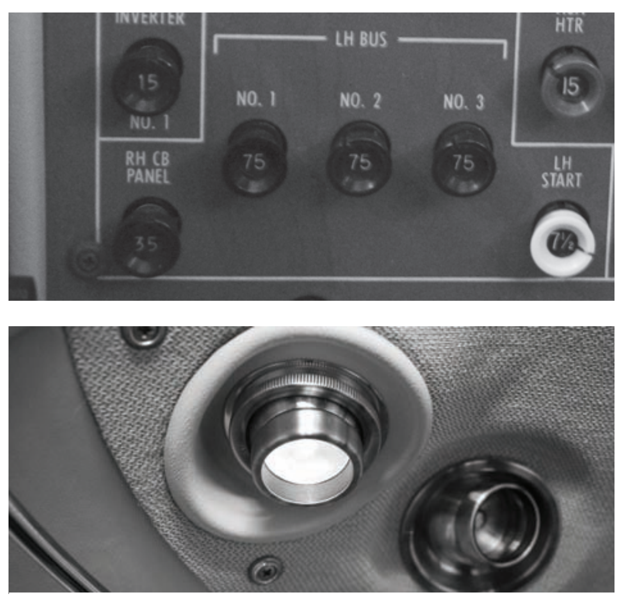


Figure 3-2. Map Lights and Controls

Electrical power to operate the map lights is routed from the right DC crossover bus for both the pilot and copilot through the RH PANEL circuit breaker on the pilot CB panel.

Control Panel Lights

The control panel lighting is provided by electroluminescent light panels, consisting of a layer of phosphor sandwiched between two electrodes and encapsulated between layers of plastic. White lettering on a grey background is used on the panel faces (Figure 3-3). Control is accomplished with the lighting rheostat EL position. Electroluminescent panels are used on the CB panels, switch panel, light control panel, environmental control panels, landing gear control panel, and each throttle pedestal control panel. Electrical power to the electroluminescent light panels is supplied by an inverter in the nose baggage compartment. The inverter is rated at 40-60 VAC and is powered through the EL PANEL circuit breaker on the left extension bus on the pilot CB panel.

Figure 3-3. Typical Control Panel Lighting

Instrument Lights

Instruments are internally lighted, and the instrument panel lights are dimmed by rheostats on the light control panel.

Power is supplied by three 5-VDC inverters. A single master switch is used to operate all instrument and panel lights. The electrical power source for the left panel lights is from the left main DC extension bus and the right crossover for the right and center panels. Circuit protection is provided through appropriately labeled circuit breakers on the left CB panel.

PASSENGER COMPARTMENT LIGHTING

The passenger compartment lighting includes all cabin lights, utility lights, and the lighted signs. Indirect fluorescent lights, passenger reading lights, and aft cabin compartment lights are mounted overhead.

The indirect fluorescent light system consists of a touch-pad switch, inverters, control units, and fluorescent bulbs.

The indirect fluorescent lights are controlled by an OFF–BRIGHT–DIM touch-pad switch mounted on a switch panel just forward and above the entrance door hinge (Figure 3-4). When the switch is placed to the BRIGHT position, the power is supplied through the two pilot inverters and the control units to the bulbs which illuminate bright. If the light switch is in the DIM position, 28 VDC is applied to the system, and the lights automatically illuminate bright for approximately three seconds, then go to dim. The power to operate the lights is routed from the left main DC bus through the INDIRECT LIGHT circuit breaker on the power junction box in the tail cone.

Figure 3-4. Cabin Lighting Controls

NOTE

It is recommended that the ground operation of the florescent lights be limited to the bright position until the engines have been started or until 28 VDC is continuously available to the lighting system. For engine battery starts, where system voltage drops below 24 VDC, operate the lights in the bright position only, until the engines are started.

The passenger reading and cabin compartment lights are mounted in the overhead console. The passenger reading lights adjust fore and aft, and each is controlled by an integrally mounted switch. The entrance, emergency exit, and aft cabin compartment lights do not have an integrally mounted switch and are not directionally controllable. They are controlled from the touch-pad switch on the forward side of the main cabin entrance door and are powered from the hot battery bus.

Lighted advisory signs are moulded into the forward and aft cabin ceiling areas (Figure 3-5). The lights are controlled by the pass safety/seat belt switch on the pilot switch panel and inform passengers when smoking is prohibited and when to fasten seat belts. The switch has three positions: Pass safety-off-seat belt. In pass safety position, both the no smoking and fasten seat belt portions of the sign are illuminated. In seat belt position only the fasten seat belt portion of the sign is illuminated. In OFF position, the sign is extinguished. Safety chimes operate in conjunction with the sign to alert the passengers when smoking is prohibited or when to fasten seat belts.

Figure 3-5. Passenger Advisory Sign

EMERGENCY LIGHTING

Emergency lighting is a separate and independent system used to provide illumination in case of primary electrical power failure or abnormal conditions. The emergency lighting consists of a battery pack, an inertia switch, and single lights that respectively illuminate the cabin entrance and the emergency exit.

The battery pack consists of 20 nickel-cadmium cells in a box. Each cell has a nominal voltage of 1.25 volts. The inertia switch is mounted near the emergency battery box above the cockpit headliner. A force of 5 Gs actuates an inertia switch and turns on the floodlights above the entry door and above the emergency exit. The emergency battery is connected to the hot battery bus and is charged by the main dc system with the generators on line.

For normal entry and exit from the aircraft, the floodlights over the entry and emergency exit doors and the aft baggage compartment light are operated from the hot battery bus by a touch-pad switch at the cabin door. For in-flight use of emergency lighting, the passenger advisory switch on the instrument panel operates the emergency exit and main cabin entrance lights when the switch is in the PASS SAFETY position. The engine instrument floodlight mounted on the underside of the engine fire warning tray illuminates anytime the engine start circuit is activated or the cockpit floodlight switch is in the ON position. It receives its power from the emergency battery bus during other than the start condition. When an engine is started, the power source for the floodlights is the emergency lights battery pack.

BAGGAGE COMPARTMENT LIGHTING

Baggage compartment lighting includes the tail cone compartment light and the nose baggage compartment light. They are wired directly to the hot battery bus and consequently do not require the battery switch to be turned on for operation.

Tail Cone

The microswitch installed in the tail cone access door frame is designed to remove 28 VDC from the lights regardless of the manual toggle switch (Figure 3-6) position when the door is closed. The manual toggle switch controls 28 VDC to the light assemblies (one in the baggage compartment and one in the forward tailcone area) when the tail cone access door is open.

Nose Baggage Compartment

The manual switch assembly of the nose baggage light system is an illuminated rocker switch (Figure 3-7). The switch is mounted overhead adjacent to the light assembly. The normal position for the manual switch applies 28 VDC to the light. During daylight hours or when the light is not desired, the manual switch is positioned to OFF, which disconnects power from the light. When the switch is in OFF and the door is pneumatically open, it is illuminated so it is easy to locate at night.

The light is turned off when both right and left nose baggage compartment doors are closed and each door hinge to the pneumatic cylinder assembly strikes its microswitch.

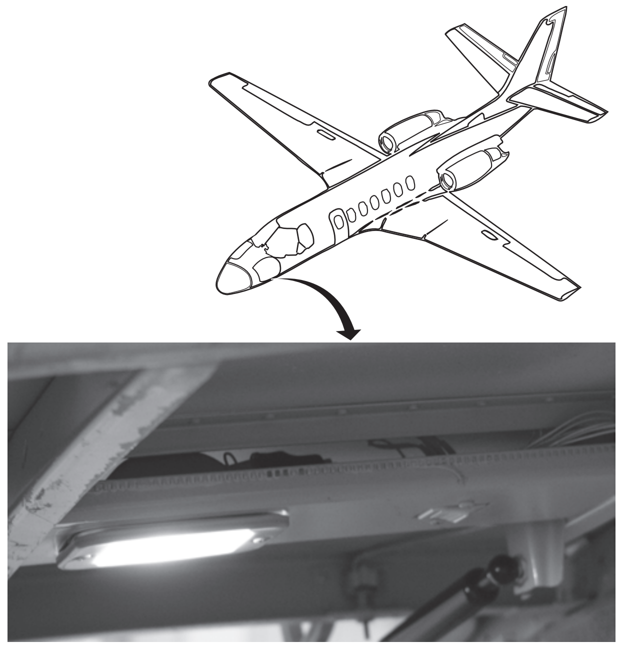


Figure 3-7. Nose Baggage Compartment Light and Switch

EXTERIOR LIGHTING

The exterior lighting system consists of navigation, anticollision, landing, taxi, wing inspection, and recognition lights, and optional tail floodlights. The exterior light system provides necessary illumination for aircraft operation

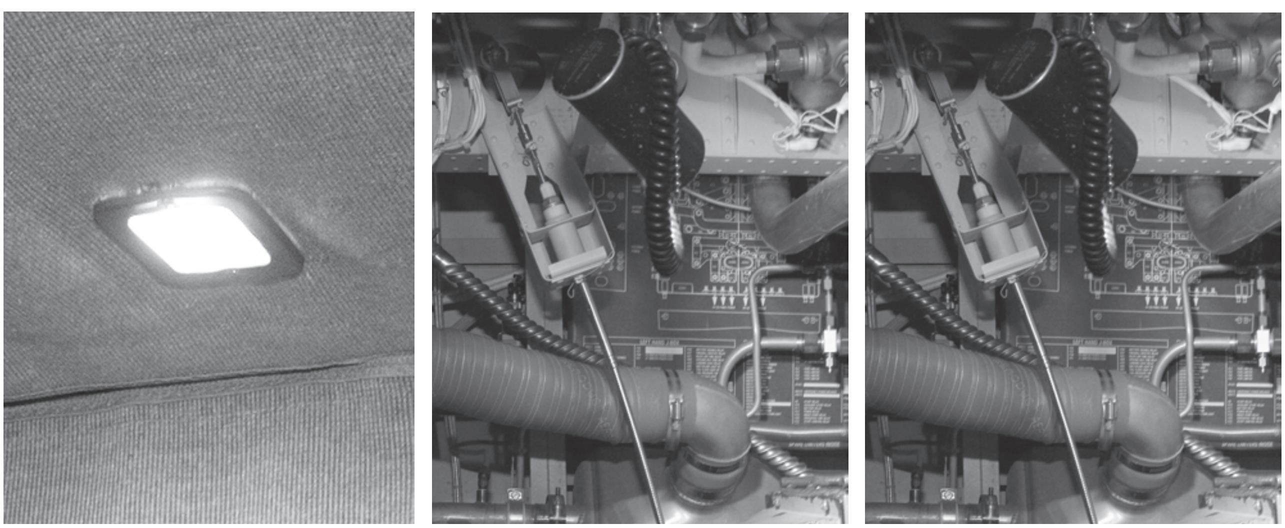


Figure 3-6. Tail Cone Lights and Switch

during the day or night. Exterior lighting locations are illustrated in Figure 3-8, and exterior lighting controls are shown in Figure 3-9.

NAVIGATION LIGHTS

A green navigation light is installed in the right wingtip, a red on the left, and a white on the tip of the tail cone (Figure 3-10).

The navigation lights are controlled with a NAV/ON–OFF switch on the instrument panel.

ANTICOLLISION LIGHTS

The anticollision lights are strobe lights mounted in each wingtip (Figure 3-10) and are controlled with the ANTI COLL/ON-OFF light switch on the instrument panel. The switch furnishes 28 volts DC power to the anticollision

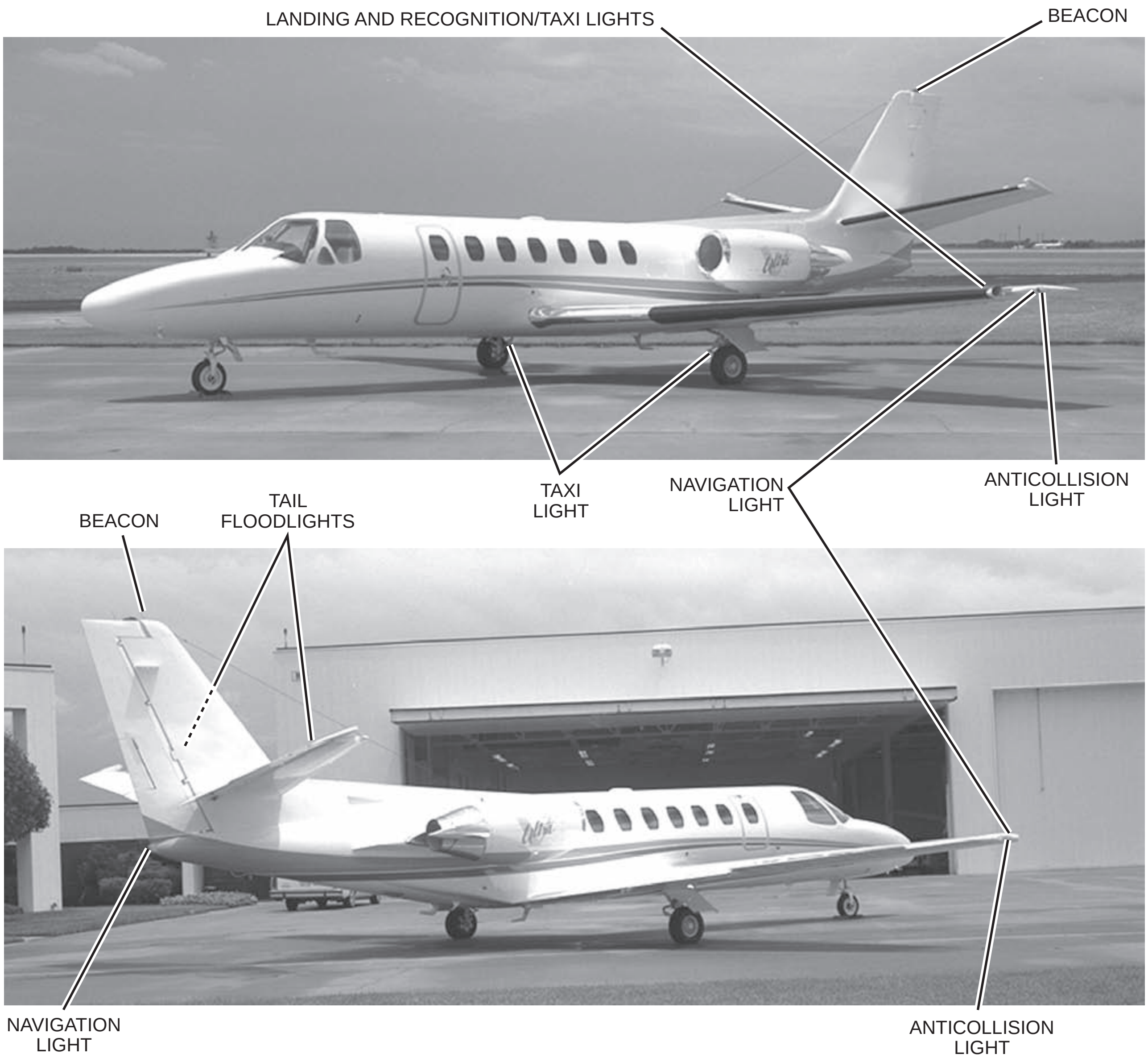


Figure 3-8. Exterior Lighting Locations

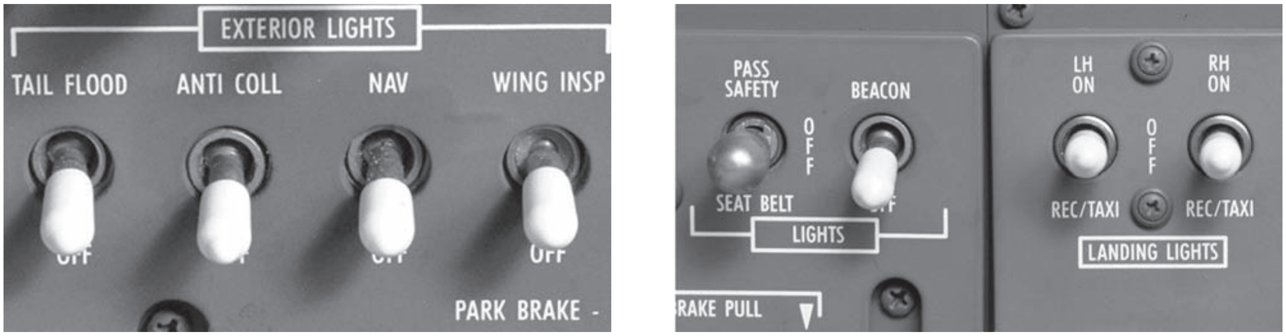


Figure 3-9. Exterior Lighting Switches

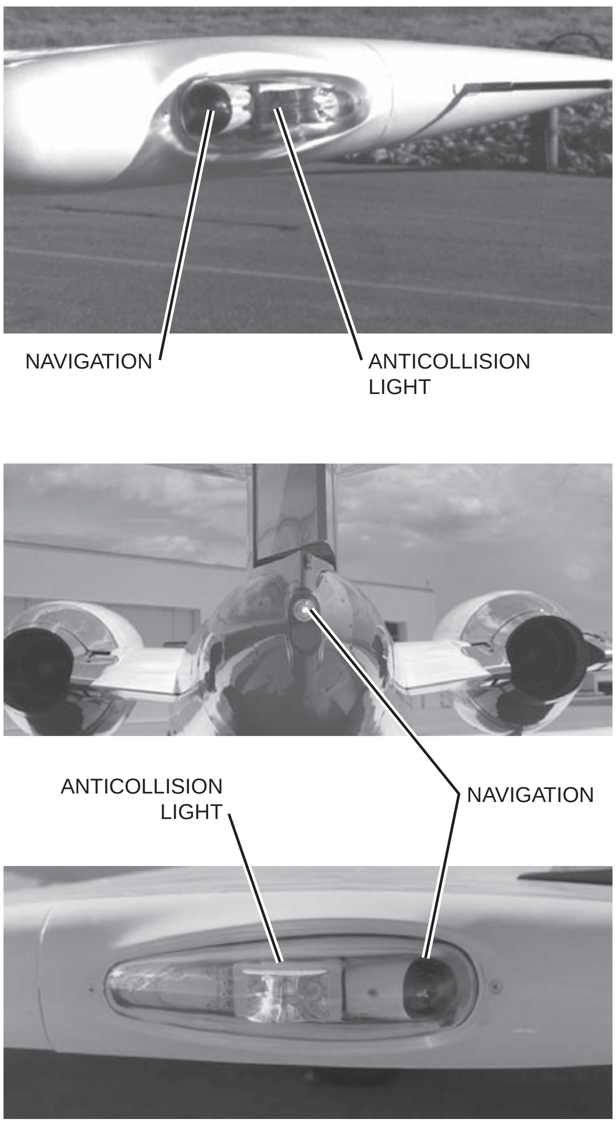


Figure 3-10. Navigation and Anticollision Lights

light power supplies. Each light has its own AC power supply. When DC power is supplied to the lighting inverters, they supply a pulsating current to the anticollision strobe lights and cause them to flash.

The beacon light is a red rotating beacon mounted on top of the vertical stabilizer (Figure 3-11). Control is with the BEACON switch on the instrument panel.

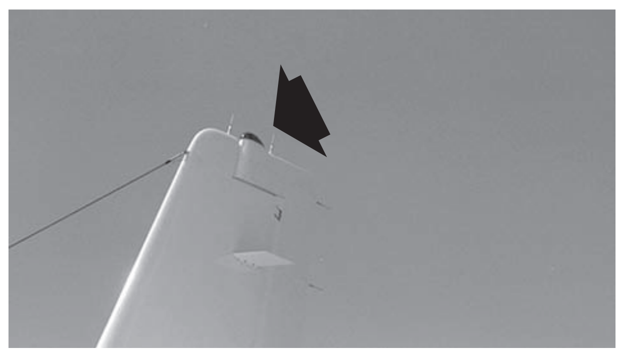


Figure 3-11. Beacon

LANDING AND RECOGNITION/TAXI LIGHTS

Landing and recognition/taxi lights are mounted side by side near the tip of each wing in the leading edge (Figure 3-12). The landing light is the outer light. Both lights are used during takeoff or landing, or the recognition/taxi lights only during taxi or inflight "see-and-avoid" situations. The four lights are fixed-position, sealed-beam lights. Each set of two lights is controlled by the LANDING LIGHTS LH/RH

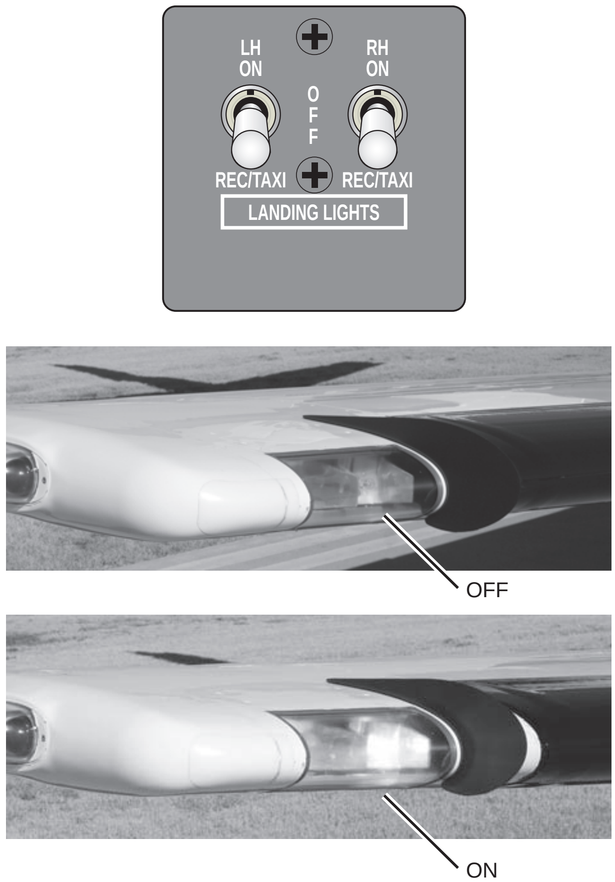


Figure 3-12. Landing and Recognition/Taxi Lights

ON–OFF–REC/TAXI switches immediately left of the gear handle. Both lights may be turned on by selecting the ON position, or the single recognition/taxi light may be selected ON in the REC/TAXI position of each LH/RH switch. A fence, mounted at the inboard edge of the lights, keeps light out of the cockpit.

NOTE

UNs 0297 and subsequent have a taxi light mounted on each main landing gear strut. The lights illuminate with the control switches positioned to ON or REC/TAXI with the gear down. SB560-33-12 allows retrofitting of UNs 0260 through 0296 with gear mounted taxi lights. The taxi light extinguishes automatically when the taxi light microswitch is completed.

Figure 3-13. Wing Inspection Light

WING INSPECTION LIGHTS

The wing inspection lights are fixed-position lights forward of each wing leading edge and mounted in the side of the fuselage (Figure 3-13). The lights are used to visually check the wing leading edges for ice accumulation. The inspection lights are controlled by a WING INSP/ON-OFF switch on the pilot switch panel.

NOTE

All wing icing inspection lights must be operative prior to flight into known or forecast icing conditions at night.

TAIL FLOODLIGHTS

The optional tail floodlights are also known as identification lights, logo lights, or telltale lights. The floodlights are fixed-position lights on the left and right horizontal stabilizers. The floodlights are used primarily for additional aircraft visibility.

The TAIL FLOOD–OFF switch (see Figure 3-9) controls these lights. The light assemblies, one installed on the top side of each horizontal stabilizer, illuminate the vertical stabilizer.

QUESTIONS

1. The lighting rheostat LEFT position controls:
   A. Pilot instrument panel lights
   B. Center instrument panel lights
   C. Copilot instrument panel lights
   D. Both A and B

2. The lighting rheostat position that controls the electroluminescent lighting is:
   A. LEFT
   B. CENTER
   C. RIGHT
   D. EL

3. Turning the PANEL LIGHT CONTROL master switch to ON:
   A. Activates the control rheostats
   B. Dims the annunciator panel lights
   C. Illuminates the STARTER DISENGAGE button
   D. All of the above

4. The map lights are controlled with rheostats on:
   A. The center pedestal
   B. The pilot and copilot instrument panels
   C. The overhead lights panel
   D. The pilot and copilot side armrests

5. When the indirect fluorescent lights are turned on and positioned to DIM, the lights illuminate:
   A. Bright for 3 seconds and then dim
   B. Dim
   C. Bright until the switch is reactuated
   D. After 3 seconds

6. The landing lights:
   A. Go out automatically upon gear extraction
   B. Must be used for inflight “see-and-avoid” situations
   C. Are normally turned on in the takeoff and approach phase
   D. All of the above

CHAPTER 4
MASTER WARNING SYSTEM

CONTENTS

ILLUSTRATION

TABLES

CHAPTER 4
MASTER WARNING SYSTEM

INTRODUCTION

The master warning system on the Citation V Ultra aircraft provides a warning of aircraft equipment malfunctions, indication of an unsafe operating condition requiring immediate attention, and indication that a system is in operation.

GENERAL

The master warning and annunciator panel lights system consists of two master warning light switches and an annunciator panel light cluster, which provides a visual indication to the operator of certain conditions and/or functions of selected systems. Each annunciator segment has a legend which illuminates to indicate an individual system fault. Red lights indicate a warning malfunction which requires immediate corrective action. Amber lights indicate either a caution malfunction that requires immediate attention, but not necessarily immediate action, or normal system operation.

ANNUNCIATOR PANEL

The annunciator panel (annunciator panel section) is on the center instrument panel and contains a cluster of caution/warning lights with selected colored lenses and legends arranged according to aircraft systems. The annunciator panel lights operate in conjunction with the master warning lights. When a system malfunctions, the associated annunciator illuminates and remains illuminated until the causative malfunction is corrected. If the illuminated light is red, the master warning lights also illuminate.

MASTER WARNING LIGHTS

There are two master warning lights, one on the pilot instrument panel and one on the copilot instrument panel. When any red light on the annunciator panel illuminates, the master warning lights illuminate simultaneously and flash until reset. There are two conditions when amber lights cause the master warning lights to illuminate. Those conditions are when both GEN OFF lights illuminate or, in flight, either thrust reverser ARM or UNLOCK light illuminates. The seriousness of these conditions warrants master warning light actuation. The master warning light system incorporates a reset switch which is actuated by pushing in on either master warning light lens. Pressing the master warning light resets the circuit and makes the system available to alert the operator should another system fault occur. The master warning light stays illuminated and flash until reset, even if the malfunction which caused the light to illuminate has been corrected. Pressing the master warning light does not normally extinguish the annunciator segment light.

INTENSITY CONTROL

The annunciator lights dim automatically when the PANEL LIGHT CONTROL toggle switch is placed in the ON position.

TEST FUNCTION

A rotary test switch is on the left side of the pilot instrument panel (Figure 4-1). Positioning the switch to ANNU causes all annunciators and the master warning lights to illuminate. Illumination verifies only annunciator lamp integrity. Some other associated system lights also illuminate when this switch is activated.

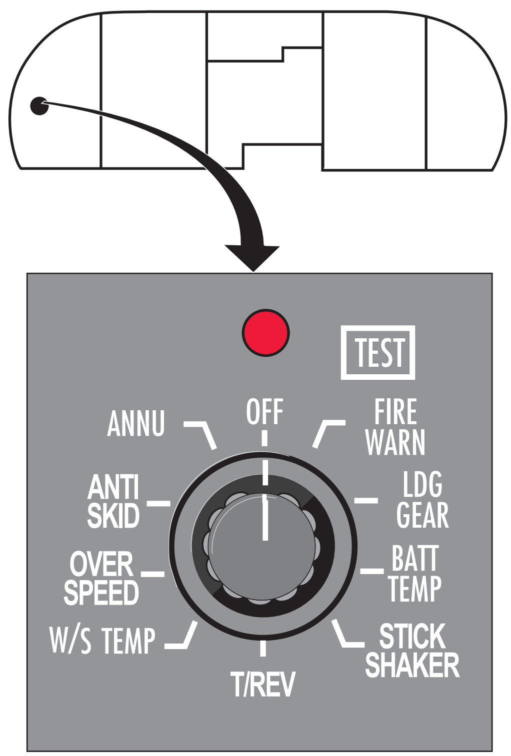


Figure 4-1. Rotary TEST Switch

ILLUMINATION CAUSES

Table 4-1 shows each annunciator light placard, color, and cause for illumination. Table 4-2 shows the same for avionics advisory lights.

Table 4-1. ANNUNCIATOR ILLUMINATION CAUSES

Annunciator	Cause for Illumination	Annunciator	Cause for Illumination
AC FAIL	The red alternating current fail light advises that one or both inverters has failed to high or low voltage. Illumination of the light also triggers the master warning light. The inverter power switch may be OFF. An AC bus CB has tripped in UNs 260–292 and 294–306.	GEN OFF LH RH	The amber generator off light advises that the left and/or right generator power relay is open. Illumination of BOTH left and right lights will trigger the master warning light.
BATT O'TEMP	The red battery overtemperature light will illuminate steady when the battery temperature is over 145° F and will flash at temperatures over 160° F. Illumination of the light also triggers the master warning light.	INVERTER FAIL 1 2	The amber inverter fail light advises that the No. 1 or No. 2 inverter has failed to high or low voltage. The failure of either inverter also triggers AC FAIL which triggers the master warning lights. Resetting the master warning light will extinguish the AC FAIL annunciation unless both inverter fail lights are illuminated. The inverter power switch may be OFF.
CAB ALT 10000 FT	The red cabin altitude light advises that the cabin pressure altitude is above 10,000 feet. Illumination of the light also triggers the master warning light.	EMERG PRESS ON	The amber emergency pressurization on light advises that emergency pressurization has been manually selected or automatically activated by an air cycle machine overheat.
OIL PRESS WARN LH RH	The red oil pressure warning light advises that the oil pressure is below safe limits in the left and/or right engines. Illumination of the light also triggers the master warning light.	BLD AIR GND	The amber bleed-air ground light advises that a high-flow rate of bleed air has been selected through the ground valve from the right engine for ground operation of the air cycle machine.
FUEL LOW LEVEL LH RH	The amber fuel low level light advises that the fuel quantity is below 185 pounds usable in the left and/or right tanks as determined by a float switch.	POWER BRAKE LOW PRESS	The amber power brake low-pressure light advises that the power brake hydraulic pressure is low.
FUEL LOW PRESS LH RH	The amber fuel low pressure light advises that the fuel pressure is low in the left and/or right engine fuel supply lines.	FUEL FLTR BYPASS LH RH	The amber fuel filter bypass light advises that the bypass of the left and/or right fuel filter is impending or actually occurring.
HYD FLOW LOW LH RH	The amber hydraulic flow low light advises that the left and/or right hydraulic pump flow rate is below normal.		
ENG ANTI-ICE LH RH	The amber engine anti-ice light advises that the left and/or right engine nacelle temperature is <220° F, the stator valve is not fully open, or the temperature of the bleed air to the inboard wing leading edge panel is <300° F, and/or the throttle is below the 63% N_2 microswitch position.	FUEL BOOST ON LH RH	The amber fuel boost on light advises that power has been applied to the left and/or right fuel boost pump.

Table 4-1. ANNUNCIATOR ILLUMINATION CAUSES (Cont)

Annunciator	Cause for Illumination
HYD LOW LEVEL HYD PRESS ON	The amber hydraulic low-level light advises that the fluid in the hydraulic reservoir is low. The amber hydraulic pressure on light advises that the hydraulic system is pressurized.
WING O-HEAT LH RH	The amber wing overheat light advises that the temperature in the inboard heated leading edge or associated ducting is excessive and the wing bleed-air valve has closed, regardless of engine anti-ice switch position.
SPEED BRAKE EXTEND	The white speedbrake extend light advises that the left and right speedbrakes are fully extended.
DOOR SEAL	The amber door seal light indicates a loss of bleed-air pressure to the primary cabin door seal.
AIR-DUCT O'HEAT	The amber air duct overheat light advises that the temperature in the duct past the ACM leading to the cabin exceeds safe limits.
ACM O'PRESS	The amber air cycle machine overpressure light advises that the primary pressure switch has failed and the secondary switch has activated the bleed-air ground valve closed.
P/S HTR OFF LH RH	The amber pitot-static heater off light advises that the pitot heat switch is off or, if the switch is on, that power has been lost to the pitot tube heater or one or both static port heaters in that system.
STBY P/S HTR OFF	The amber standby pitot/static heater off light advises that the pitot heater switch is off or, if the switch is on, that power has been lost to the standby pitot tube heater or either standby static port heater in that system.
BAGGAGE DOOR LH RH	The amber baggage door-not-locked light advises that either nose baggage door has not been key locked
F/W SHUT OFF LH RH	The amber firewall shutoff light advises that the left or right fuel and hydraulic shutoff valves are both fully closed.
W/S AIR O'HEAT	The amber windshield air overheat light advises that the bleed air to the windshield exceeds safe temperature limits with the control switch in HI or LOW. With the switch in OFF, it is triggered by a pressure switch which indicates that the control valve may be leaking.
AOA HTR FAIL	The amber angle-of attack heater fail light advises that the heating element in the probe is inoperative, or the pitot heat switch is off.
SURFACE DE-ICE	Illumination of the white surface deice light twice during the 18-second boot cycle indicates proper boot inflation pressure.
ANTI-SKID INOP	The amber antiskid inoperative light advises that the antiskid system is inoperative or the control switch is in the off position.
GROUND IDLE	The amber ground idle light advises that the engines are configured for reduced idle. The ground idle switch is in normal and on the ground.
CABIN DOOR	The amber cabin door-not-locked light advises that the main cabin door is not secure.
TAILCONE DOOR	The amber tailcone door light advises that the tailcone door is not key locked

Table 4-2. AVIONICS ADVISORY LIGHTS ILLUMINATION CAUSES

Advisory Light	Reason for Illumination	Advisory Light	Reason for Illumination
NOSE FAN FAIL	The amber nose avionics fan fail light advises that the nose avionics fan is inoperative. Limit ground operations to 30 minutes due to heat in the nose. If inflight, continue normally.	CHECK PFD 1 CHECK PFD 2	The amber CHECK PFD 1 or CHECK PFD 2 light indicates the IC-600 display guidance computer detects a wrap-around failure (miscompare) in the respective PFD. Data is not being updated. Certain heading, FMS, and MADC failures not normally compared are monitored by these lights that also appear in the upper LH corner of the MFD.
AP PITCH MISTRIM	The amber autopilot pitch mis-trim light matches the out-of-trim lights on the autopilot and advises to be ready for pitch forces to maintain flight path if the autopilot is un-clutched.	FMS HDG	The green FMS heading light reminds that current heading is being maintained by programming the heading through the LRN heading key pages and not by the flight director panel heading key mode.
AP ROLL MISTRIM	The amber autopilot roll mis-trim light advises to be ready for minor control wheel forces to maintain flight path if the autopilot is un-clutched.	FMS WPT	The amber FMS waypoint light advises that the airplane is within 60 seconds of the current TO WPT and is about to turn to the desired track to the next WPT if in AUTO. If in MANUAL, the pilot must make the turn manually.

AUDIO WARNING SYSTEM

Various audio warnings are incorporated into aircraft systems that warn of specific conditions and malfunctions. The systems, sounds, and conditions for actuation are shown in Table 4-3.

Provision to test the audio system and various other system functions is provided and wired into the same rotary test switch that is used to test the annunciator system. When the switch is rotated through each position, the associated system functions as described in Table 4-3 occurs.

Table 4-3. TEST INDICATIONS

Switch Position	Indication
OFF	The red light is extinguished and the test system is inoperative.
FIRE WARN	Illumination of both red ENG FIRE lights occurs.
LDG GEAR	Illumination of the green NOSE, LH, RH, and the red GEAR UNLOCKED lights, and sounding of the gear warning horn occurs. The horn can be cancelled if flaps are less than 15 degrees.
BATT TEMP	BATT O'TEMP annunciator illuminates and flashes, the master warning lights illuminate, and the battery temperature gage indicates 160° F.
STICK SHAKER (Vane Type)	The stick shaker will operate. The AOA needle will go past the red area, and the optional indexer lights will flash on and off.

Switch Position	Indication
T/REV	The thrust reverser indicator and master warning lights illuminate.
W/S TEMP	The W/S AIR O'HEAT light will illuminate if LOW or HIGH is selected on the windshield bleed air switch.
OVER SPEED	Both avionics switches should be on. The audible Mach warning signal sounds and PFD-V_{MO} in red, Mach .4 (red), altitude 5,000 feet, and PFD 1/2 vertical speed momentarily reads 2,000 ft/min.
ANTI SKID	The ANTISKID INOP annunciator illuminates for 3 or 4 seconds then goes out.
ANNU	All of the annunciator panel lights and the master warning lights illuminate. Also, the engine instrument LCDs will show all 8s and will flash. Both red turbine lights will illuminate steady. With both avionics switches ON, the altitude alert horn sounds and EFIS, FMS, F/D, A/P, and altitude alert lights display. Master warning will not cancel. All of the avionics strip lights next to the MFD and PFDs also illuminate with the lights on the autopilot control panel, AP OFF, YD OFF, and the FD mode panel lights.

QUESTIONS

1. An annunciator panel light extinguishes:
   A. When pressed
   B. Upon landing
   C. When the malfunction is corrected
   D. If the master warning system is reset under all conditions

2. The master warning lights illuminate:
   A. When any annunciator panel light illuminates
   B. When a red annunciator panel light illuminates
   C. When both GEN OFF annunciators illuminate
   D. Both B and C

3. The rotary test switch:
   A. Illuminates all annunciators in the ANNU position
   B. Is spring-loaded to OFF
   C. Only illuminates all red annunciators in the ANNU position
   D. Only illuminates all amber annunciators in the ANNU position

CHAPTER 5
FUEL SYSTEM

CONTENTS

Page

ILLUSTRATIONS

CHAPTER 5
FUEL SYSTEM

INTRODUCTION

This chapter presents the Citation V Ultra aircraft fuel system. Each wing contains a fuel tank that normally supplies its respective engine; however, fuel crossfeed capability is provided.

GENERAL

Two tanks, one in each wing, provide fuel for the engines. Fuel flow to the engines is accomplished with electrically driven boost pumps and an ejector pump, one in each tank. The system is controlled by switches and a selector on the pilot's instrument panel, and is monitored by colored annunciator lights and gauges. The airframe fuel system up to the engine-driven fuel pump is presented in this chapter. For description and operation of the engine fuel system, refer to Chapter 7—"Powerplant."

DESCRIPTION AND OPERATION

FUEL STORAGE

Tanks

The wet wing fuel tank in each wing is an integral part of the wing structure, sealed to contain fuel. Each tank includes all the wing area forward of the rear spar, except the main gear wheel well. Holes in spars and ribs permit fuel movement within the tanks; however, baffles in outboard ribs prevent rapid movement of fuel outboard during wing-low attitudes. Each tank includes a vent system, fuel quantity probes, a filler cap, sump drains, ejector pumps, and an electrically driven boost pump. Combined usable fuel quantity of both tanks is approximately 5,814 pounds.

Tank Vents

A vent system is installed in each wing to maintain positive internal tank pressures within the structural limitations of the wing. It permits overflow of fuel due to thermal expansion and equalization of pressure within the tank as fuel is consumed. The vent (Figure 5-1) is anti-iced by design.

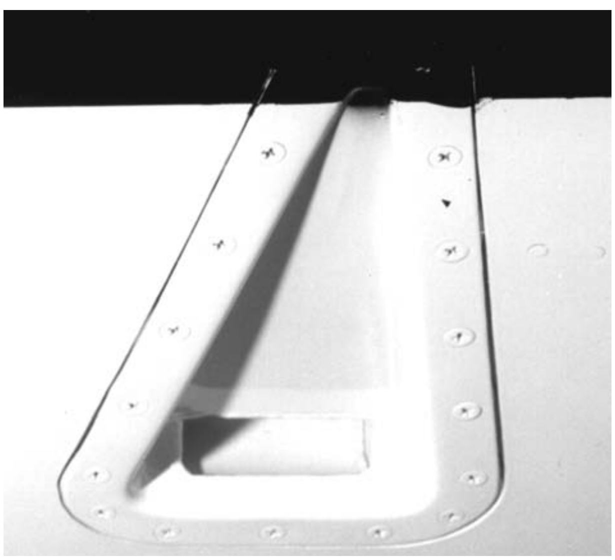


Figure 5-1. Fuel Vent Scoop

Tank Filler

One flush-mounted fuel filler assembly, located on the upper surface of each wing near the outboard end, is used for normal fuel servicing. The filler assembly consists of an adapter, standpipe, cap, and a chain to attach the cap to the adapter.

Identical filler assemblies are used on each wing. Each cap is recessed for the flush fitting handles and marked to indicate open and closed positions. To remove the cap, lift the handle and rotate counterclockwise.

Drain Valves

Six fuel quick-drain valves and one filter drain valve are provided for each tank. Figure 5-2 shows a typical drain and drain locations on the lower side of the left wing. Locations for the right wing are identical.

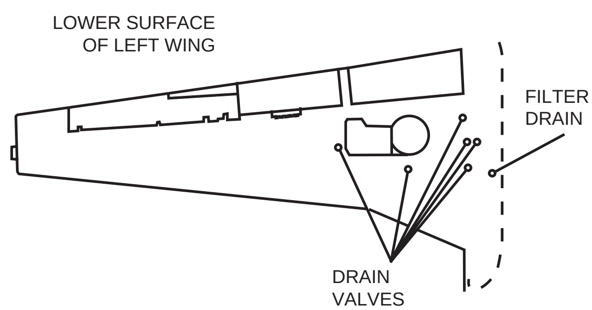


Figure 5-2. Drain Valves

The drains are used to remove moisture and sediment from the fuel and to drain residual fuel for maintenance. Each drain contains a spring-loaded poppet that can be unseated for fuel drainage.

MAJOR COMPONENTS

Boost Pumps

One 28-VDC boost pump in each tank supplies fuel to the engine-driven fuel pump. The pump supplies fuel to the respective engine and cross-feed fuel to the opposite engine, or it can feed both engines. The pumps are controlled by switches on the pilot's instrument panel. The LH and RH main DC buses supply power for boost pump operation.

Ejector Pumps

There are four ejector pumps in each wing fuel system, each powered by motive-flow fuel and operated on the venturi principle. One of the ejectors (primary) receives motive flow from the engine-driven fuel pump and is the primary source of pressurized fuel to the engine-driven fuel pump. The other three transfer ejectors operate on motive flow from the primary ejector or boost pump, and transfer fuel from the lowest point in the tank to the sump. Figure 5-3 shows a functional schematic of an ejector pump.

Crossfeed Valve

Two electrically operated motor-driven crossfeed valves, normally closed to isolate the right wing and left wing fuel systems, are electrically operated by a selector on the pilot's instrument panel. Valve opening or closing is indicated by momentary illumination of a green IN TRANSIT light near the selector. When the valves are open, fuel flow can occur from either tank to the opposite wing fuel system.

Filter

One filter is installed in the engine fuel supply line of each wing fuel system. The filter incorporates a differential pressure switch that illuminates the amber FUEL FLTR BYPASS LH/RH annunciator to warn of an impending filter bypass. If the annunciator illuminates, the filter must be inspected upon landing to determine the cause of the contamination that blocked the filter.

Shutoff Valves

Firewall

Electrically operated motor-driven firewall shutoff valves, one in each engine fuel supply line, are controlled by red ENG FIRE switchlights on the glareshield. Normally, the valves are to be closed only in the event of engine fire. When both the fuel and hydraulic firewall shutoff valves are closed, the applicable amber F/W SHUT OFF annunciator illuminates.

NOTE

If an engine is shut down in flight for reasons other than fire, the valve must be left open and the boost pump operated to prevent damage to the engine-driven fuel pump.

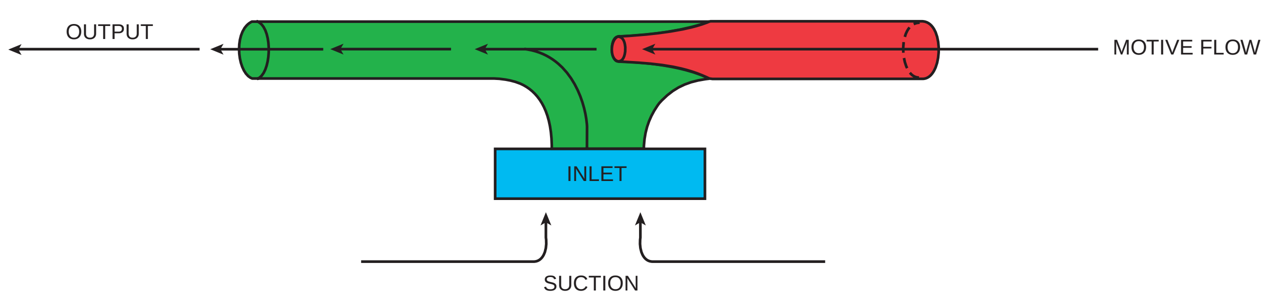


Figure 5-3. Ejector Pump

Motive Flow

One solenoid-operated motive-flow shutoff valve in each wing fuel system controls motive-flow fuel from the engine-driven pump to the primary ejector pump. The valves are normally open. During crossfeed operation, the valve to the tank not supplying fuel closes when crossfeed is selected. There is no indication of valve position.

Manual Shutoff Valve

A manual shutoff valve is provided in each wing fuel system. The normally open valve, located in the inner wing dry bay area, is for maintenance use only and is not accessible in flight.

CONTROLS

Controls for the fuel system are located on the pilot's instrument panel (Figure 5-4). The LH and RH FUEL BOOST pump switches control the electrically driven boost pumps. Each switch has positions labeled NORM-OFF-ON. During normal operation of the fuel system, the *NORM* position is selected. In this position, the boost pump operates *automatically* during: 1) engine start, 2) crossfeed operation, or 3) when low fuel pressure is sensed in the engine fuel supply line. If the throttle is in cutoff, the boost pump does not come on automatically for a low fuel pressure condition, even though the switch is in NORM.

When the switch is in the *OFF* position, the boost pump operates *automatically* for: 1) engine start and 2) when crossfeed is selected from that tank. In the ON position, the pump operates continuously.

The CROSSFEED selector has three positions labeled LH TANK-OFF-RH TANK.'' Moving the selector out of OFF to either of the operating positions selects the tank from which fuel is to be taken and the engine to be supplied.

Detailed operation of the fuel system during normal and crossfeed operation is presented under Operation later in this chapter.

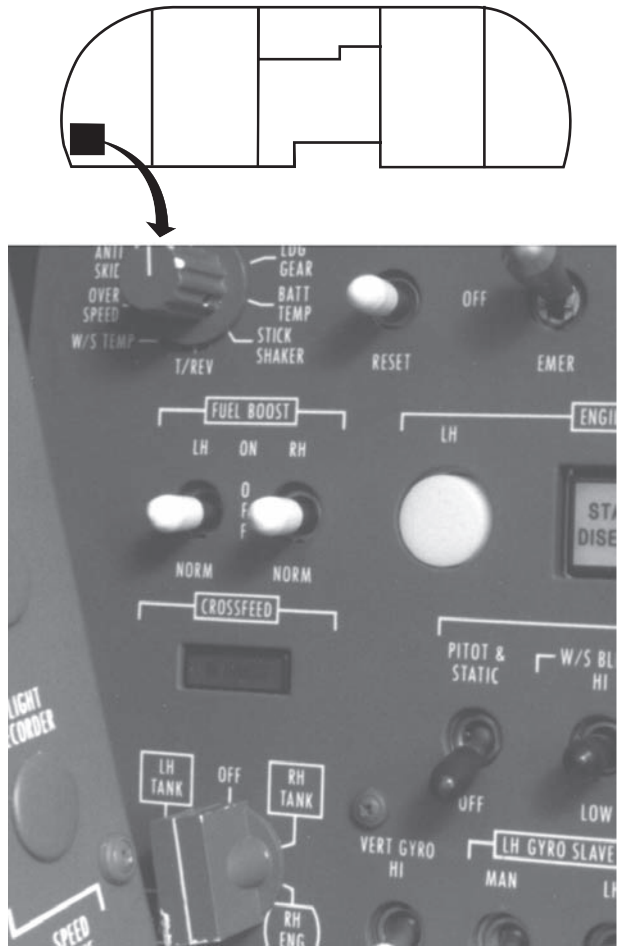


Figure 5-4. Fuel System Controls

INDICATING SYSTEM

Quantity Indication

The fuel system has a capacitance-probe quantity indicating system which compensates for changes in density caused by temperature changes. Each tank contains six quantity probes that supply quantity information to the dual indicating FUEL QTY indicator on the center instrument panel (Figure 5-5). The indicator is a vertical scale instrument displaying quantity in pounds for left and right tanks.

The indicator operates on 28 VDC through FUEL QTY circuit breakers on the left and

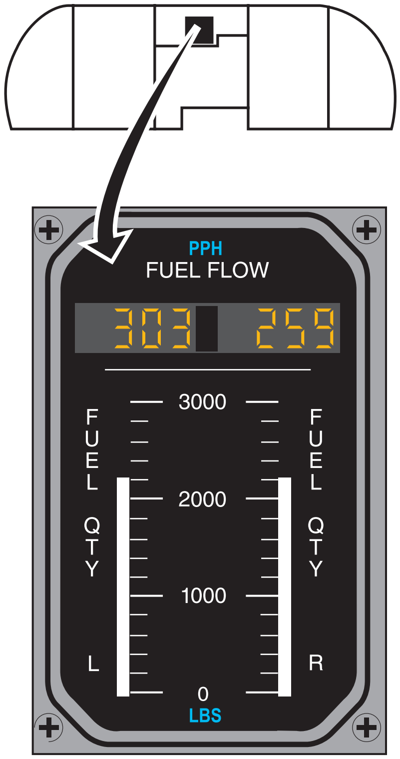


Figure 5-5. FUEL QTY and FUEL FLOW Indicators

right circuit-breaker panels. These are powered from the left and right extension buses, respectively. Power loss to either scale of the indicator is indicated by the appearance of a red OFF flag at the top of the scale.

Annunciator Lights

There are five annunciator lights associated with the fuel system, each incorporating a LH and RH capsule, one of which also illuminates with the annunciator. All are shown in the Annunciator Panel section.

The amber F/W SHUT OFF light illuminates when both the fuel and hydraulic firewall shutoff valves have been fully closed by depressing the ENG FIRE switchlight. Depressing the ENG FIRE switchlight a second time opens the shutoff valves and turns off the F/W SHUT OFF light.

The amber FUEL LOW PRESS light comes on when fuel pressure drops below 5 psi, and goes out at 7 psi increasing pressure.

The amber FUEL LOW LEVEL light, actuated by a float switch, comes on when usable fuel in a tank drops to approximately 185 pounds.

The amber FUEL BOOST ON light illuminates when the boost pump is energized for operation.

A differential pressure of approximately 4 psi across the fuel filter illuminates the amber FUEL FLTR BYPASS light. This indicates that the filter is on the verge of bypassing, and the element must be inspected upon landing.

In addition to the annunciator lights, a green IN TRANSIT light illuminates when power is applied to open (or close) the two motor-driven crossfeed valves and does not extinguish until both valves are fully opened (or closed).

OPERATION

Normal

With the FUEL BOOST pump switch in NORM, depressing an engine START button energizes the fuel boost pump, moving fuel through the manual shutoff valve, fuel filter, and firewall shutoff valve to the engine-driven fuel pump (Figure 5-6).

When the engine start terminates, the boost pump is deenergized (FUEL BOOST ON light goes out). Motive-flow fuel from the engine-driven pump is directed to the primary ejector pump, which continues to supply fuel for the engine-driven fuel pump. Flow from the primary ejector pump is also directed to the three transfer ejector pumps which transfer fuel from the lowest point in the tank to the sump. The crossfeed valves are closed; therefore, each engine is being supplied from its respective wing tank.

The firewall shutoff valve is normally open; it can be closed by depressing the ENG FIRE switchlight in the event of an engine fire. Valve

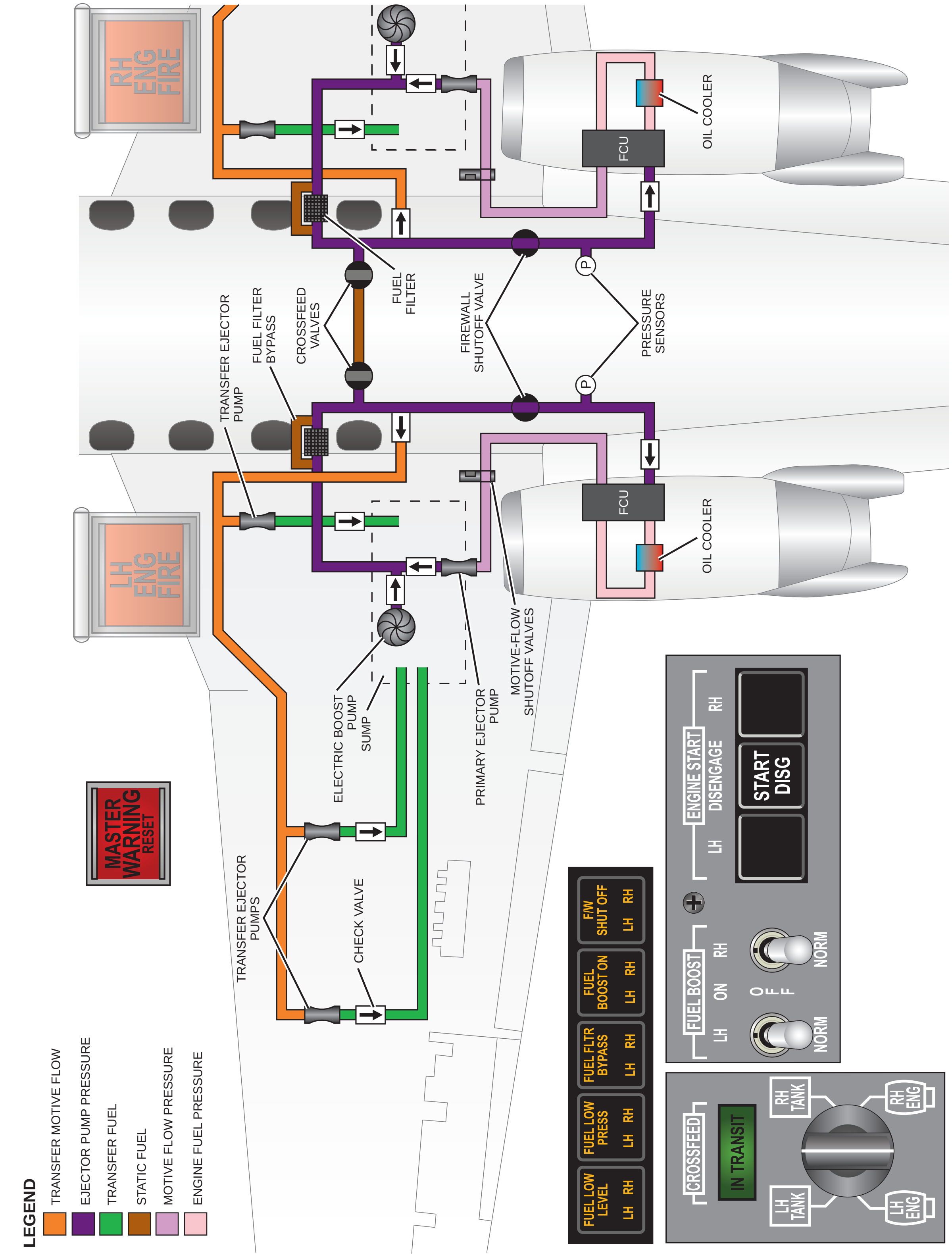


Figure 5-6. Fuel System Normal Operation

closing is indicated by illumination of the amber F/W SHUT OFF annunciator.

A pressure switch illuminates the FUEL LOW PRESS annunciator if fuel pressure becomes too low. If the FUEL BOOST pump switch is in NORM, the boost pump is energized as indicated by illumination of the FUEL BOOST ON annunciator. If the boost pump can build the pressure up in the fuel supply line, the FUEL LOW PRESS light goes out. However, the boost pump remains on once it is tripped on.

Crossfeed

Using the crossfeed system, either engine can be supplied from the opposite wing tank, or both engines can be supplied from the same tank.

As an example, placing the crossfeed selector (Figure 5-7) in the LH TANK position electrically opens both crossfeed valves (green IN TRANSIT light is on during valve opening) and energizes the boost pump in the left tank (FUEL BOOST ON LH annunciator illuminates). Three seconds after the green IN TRANSIT light goes out, the right motive-flow shutoff valve is energized closed.The time delay is built in to give the crossfeed valves time and stabilize fuel pressure before the motive-flow pressure is shutoff from the right engine (terminates right primary ejector pump).

Left tank boost pump pressure supplies fuel to the left engine; it also supplies fuel to the right engine through the open crossfeed valves. Since the motive-flow shutoff valve in the right fuel system is closed, motive-flow fuel from the right engine-driven pump cannot flow to the primary ejector pump in the right tank. Therefore, no fuel pressure from the right tank can oppose the crossfeed pressure from the left tank, and both engines are being fed from the left tank.

A portion of the fuel being crossfed from the left to the right fuel system is directed through the transfer ejector pumps into the right tank; therefore, left tank fuel is also being transferred to the right tank. Transfer rate is approximately 900 pounds per hour. Monitor the FUEL QTY indicator on the pilot's instrument panel (Figure 5-5) for fuel balancing. To verify that crossfeed is in fact occurring, it is necessary to monitor the fuel quantity tapes to observe the quantity decreasing in the tank selected and the quantity increasing in the opposite tank.

To terminate crossfeed and return the system to normal operation, move the crossfeed selector to OFF. This immediately opens the right motive-flow shutoff valve. A few seconds later (again on a time delay), the boost pump is deenergized and both crossfeed valves are closed (IN TRANSIT light on until the valves fully close). The system is now back to normal operation, each engine being supplied by its respective tank.

If electrical power fails during crossfeed operation, both motor-driven crossfeed valves fail in the position attained at the time of power loss. The motive-flow valve fails open. If both engines are operating, crossfeed ceases since each engine pressure output is essentially equal.

NOTE

If both fuel boost ON annunciators come on when crossfeed is selected, both boost pumps have been energized and crossfeed cannot occur. Cycle the fuel boost pump switch for the nonselected tank to on, then back to norm. This should deenergize the pump in the tank not selected and allow crossfeed to begin.

FUEL SERVICING

Fuel servicing includes those procedures necessary for fueling, adding anti-icing additives, and checking for contaminants and condensation in the fuel.

Fueling is accomplished through flush filler caps, one on the outboard section of each wing.

Anti-icing additives use is mandatory for all Citation V ULTRA aircraft.

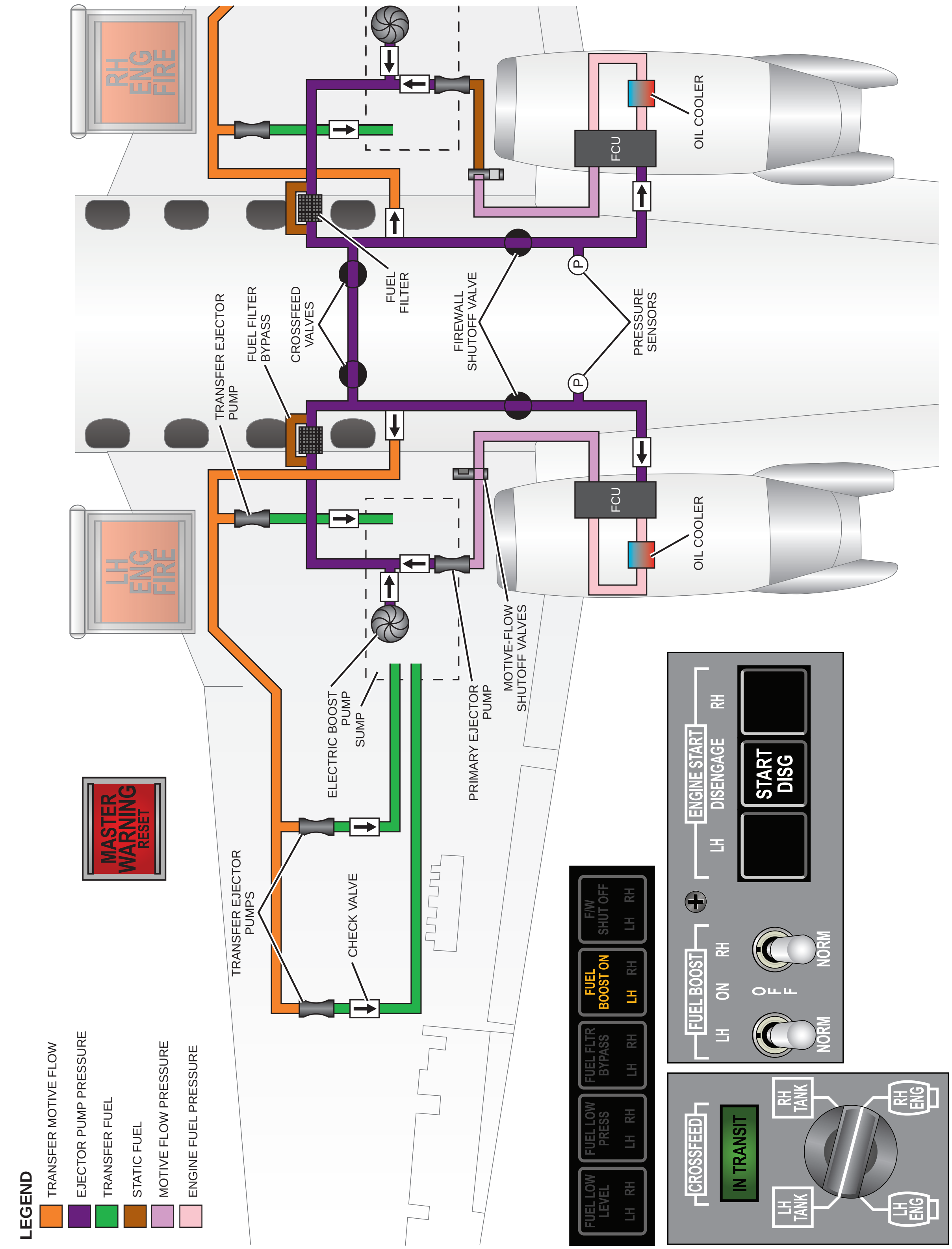


Figure 5-7. Fuel System Crossfeed (Left Tank Supplying Both Engines)

SAFETY PRECAUTIONS

Refueling should be accomplished only in areas which permit free movement of fire equipment. Follow approved grounding procedures for the aircraft and the tender.

If anti-icing inhibitor is required to be added to fuels not containing the additive during refueling operations, refer to the Normal Procedures section of the FAA approved *Airplane Flight Manual (AFM)* and section IV, Servicing, of the Operating Manual for instructions concerning procedures, quantities, and equipment to be used in treating the fuel with anti-icing additive.

SINGLE-POINT PRESSURE REFUELING UNs 0293, 0307, AND ON

The single-point pressure refueling (SPPR) system, illustrated in Figure 5-8 is capable of refueling or defueling any combination of tanks. The single-point refueling panel is located inside a door on the lower tail cone under the right engine. Refueling instructions are located on the inside of the door, as depicted in Figure 5-9. Maximum refueling pressure is 60 psi (413 kpag) and a maximum fuel flow of 105 gpm (397 lpm). Electrical power is not required for the single-point refueling system to operate.

Precheck

To refuel via the single-point method, remove the dust cover (adapter cap) from the refueling adapter and connect the refueling nozzle.

Start the fuel flow and allow flow to stabilize, then lower (open) the left and right tank precheck levers. The flow (totalizer) should show zero fuel flow within 30 seconds per placard instructions on the door. If flow does not terminate on the precheck, terminate single-point refueling and fuel the aircraft using the overwing port in each tank.

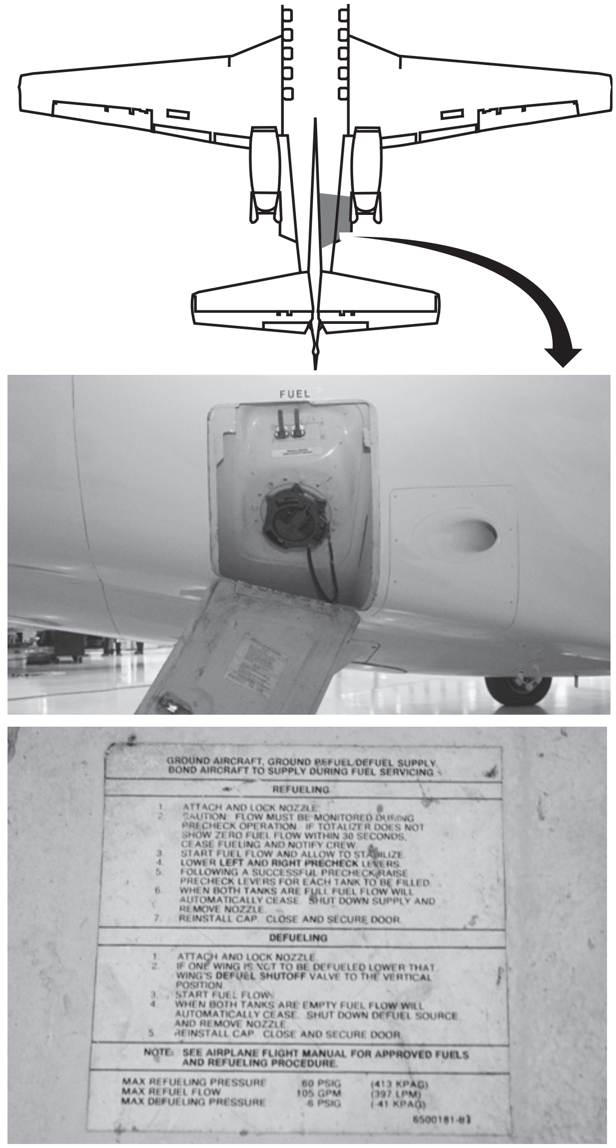
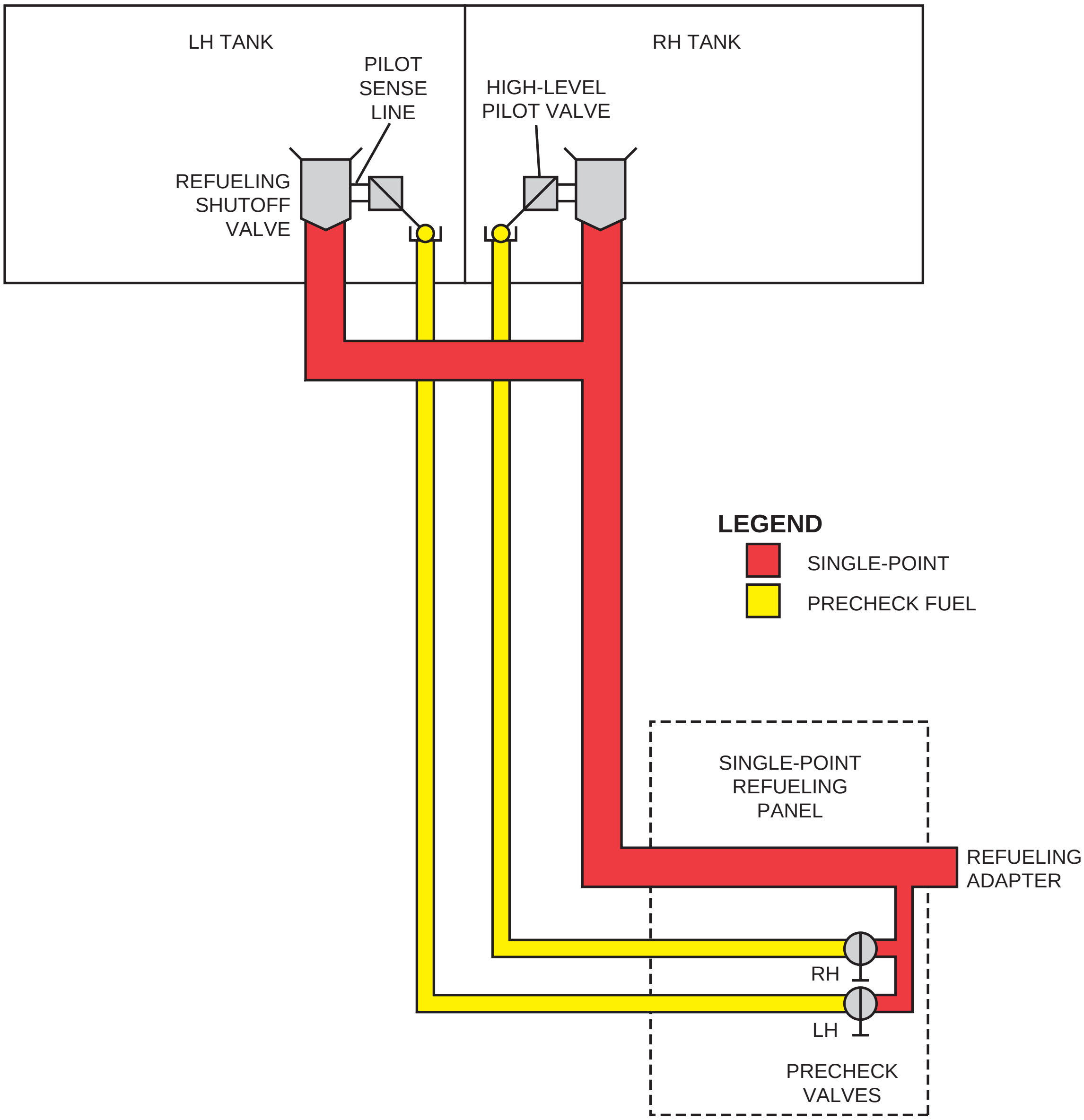


Figure 5-9. Single-Point Pressure Refueling Panel

Refueling

After the system has made a successful precheck, raise the precheck levers to refuel. When the tanks are full, the system shuts off just as with the precheck. Turn off the fuel truck or hydrant pump, and remove the hose and grounds from the aircraft. Replace the dust cover, and close the door.



CITATION V ULTRA UNs 0293, 0307 AND SUBSEQUENT

Figure 5-8. Single-Point Pressure Refueling System (SPPR)

NOTE

The door will not close unless all precheck levers are in the raised (closed) position.

For a fuel imbalance, compute the number of gallons to be loaded in each wing.

After the precheck, leave one precheck lever lowered (open) and add the desired quantity to the other. Use the truck or hydrant meter to aid in determining the desired quantity. When the first tank is fueled to the desired level, repeat the steps with the other tank.

Defueling

Both wings may be defueled by connecting the single-point nozzle and applying suction. Maximum allowable suction is –6 psi (–41 kpag) to draw fuel from the wing tanks. Be sure both precheck levers are raised (closed) and both manual defuel shutoff levers are at the horizontal (closed) position.

One or both wing tanks may be prevented from defueling. This is accomplished by the left and right manual defuel valves located under a door in the forward, under-wing, stub area, as shown in Figure 5-10. To prevent a wing tank from defueling, open the appropriate door and move the manual defuel valve to the vertical (open) position. This prevents defueling that wing.

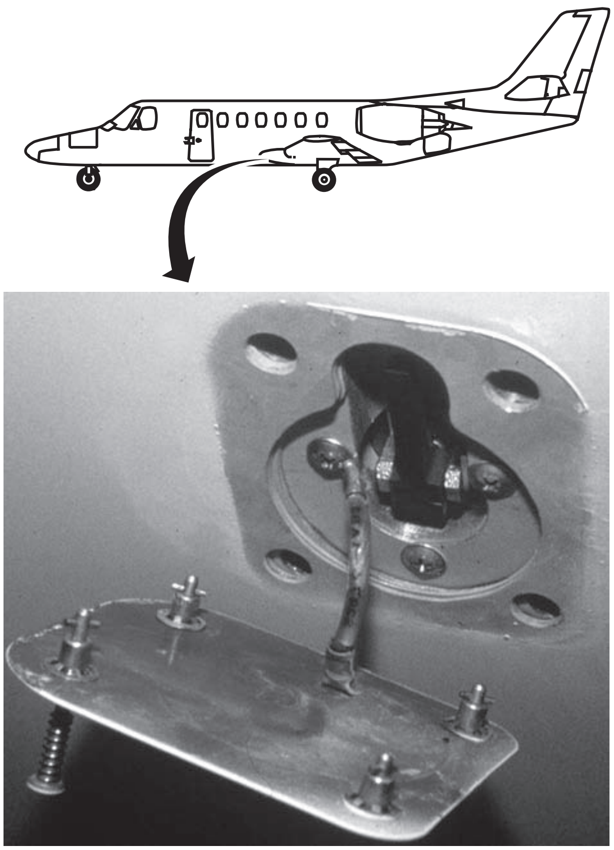


Figure 5-10. Wing Defuel Valve

Defueling should take the fuel down to 200 pounds or less. The RH wing defuels slightly faster than the LH wing. It may be necessary to open the RH defuel shutoff valve just prior to shut down to allow the LH tank to defuel completely.

NOTE

The manual defuel shutoff valve access doors will not close unless the defuel valve levers are returned to the horizontal (closed) position.

Single-point refueling operations must be accomplished per the procedures contained on the placard installed on the single-point refueling access door (Figure 5-11).

INSTRUCTION LABEL INSIDE SPPR DOOR.

GROUND AIRCRAFT, GROUND REFUEL/DEFUEL SUPPLY
BOND AIRCRAFT TO SUPPLY DURING FUEL SERVICING

REFUELING

1. ATTACH AND LOCK NOZZLE
2. CAUTION: FLOW MUST BE MONITORED DURING PRECHECK OPERATION. IF TOTALIZER DOES NOT SHOW ZERO FUEL FLOW WITHIN 30 SECONDS CEASE FUELING AND NOTIFY CREW.
3. START FUEL FLOW AND ALLOW TO STABILIZE
4. LOWER LEFT AND RIGHT PRECHECK LEVERS.
5. FOLLOWING A SUCCESSFUL PRECHECK RAISE PRECHECK LEVERS FOR EACH TANK TO BE FILLED
6. WHEN BOTH TANKS ARE FULL FUEL FLOW WILL AUTOMATICALLY CEASE. SHUT DOWN SUPPLY AND REMOVE NOZZLE
7. REINSTALL CAP, CLOSE AND SECURE DOOR.

DEFUELING

1. ATTACH AND LOCK NOZZLE.
2. IF ONE WING IS NOT TO BE DEFUELED LOWER THAT WING'S DEFUEL SHUTOFF VALVE TO THE VERTICAL POSITION.
3. START FUEL FLOW.
4. WHEN BOTH TANKS ARE EMPTY FUEL FLOW WILL AUTOMATICALLY CEASE SHUT DOWN DEFUEL SOURCE AND REMOVE NOZZLE
5. REINSTALL CAP, CLOSE AND SECURE DOOR

NOTE: SEE AIRPLANE FLIGHT MANUAL FOR APPROVED FUELS AND REFUELING PROCEDURE.

MAX REFUELING PRESSURE	60 PSIG (413 KPAG)
MAX REFUEL FLOW	105 GPM (397 LPM)
MAX DEFUELING PRESSURE	–6 PSIG (–41 KPAG)

Figure 5-11. Single-Point Instructions Placard

OVERWING REFUELING

One flush-mounted fuel filler cap is located on the upper surface of each wing near the tip, as shown in Figure 5-12.

Approved fuels for operation of Citation V Ultra aircraft are listed in the Limitations chapter.

LIMITATIONS

For specific information on limitations, refer to the appropriate abbreviated checklists or the FAA-approved *AFM.*

LOCKED

UNLOCKED

OPEN

Figure 5-12. Filler Port (Typical)

QUESTIONS

1. Concerning the fuel system, the incorrect statement is:

A. The FUEL BOOST pump switches do not have to be on for the engine start.

B. With the FUEL BOOST pump switches off, the respective boost pump automatically energizes whenever the respective START button is depressed, or when crossfeed from that tank is selected.

C. It is normal for both fuel boost pumps to be operated during crossfeed operation.

D. The fuel boost pump automatically energizes anytime the FUEL BOOST switches are in NORM and the START button is depressed, crossfeed is selected, or low pressure (5 psi) is sensed in the engine supply line (throttle at IDLE or above).

2. After engine start, the fuel boost pump is deenergized by:

A. The FUEL BOOST pump switch

B. The generator speed sensor switch

C. Discontinuing crossfeed

D. A time-delay relay

3. Concerning the fuel system, the correct statement is:

A. In the event of DC power loss, the primary ejector pump ceases to operate and the engine flames out.

B. The respective engine should be shut down if the respective FUEL FLTR BYPASS annunciator illuminates.

C. The FUEL BOOST switches should be on for takeoff and landing.

D. The fuel filter should be inspected prior to the next flight if the FUEL FLTR BYPASS light illuminates.

4. If the FUEL BOOST ON LH/RH annunciators illuminate without any action by the crew (engine operating normally), the probable cause is:

A. The engine-driven fuel pump has failed.

B. The fire wall shutoff valve has closed.

C. The low-pressure sensing switch has energized the boost pumps.

D. The fuel flow compensator has energized the boost pumps below 5 psi.

5. To verify that crossfeed is in fact occurring, it is necessary to:

A. Monitor the FUEL QTY indicators for appropriate quantity changes.

b. Only observe that the IN TRANSIT light is out.

c. Ensure both FUEL BOOST ON lights are illuminated.

d. Ensure that the FUEL BOOST pump switch for the tank being fed is on.

6. When crossfeed is selected by positioning the crossfeed switch to LH TANK, and the green IN TRANSIT light stays on:

A. This is normal.

B. The boost pumps did not actuate.

C. One or both crossfeed valves did not fully close.

D. One or both crossfeed valves did not fully open.

7. Operation of the primary ejector pump is directly dependent upon:

A. DC electrical power

B. High-pressure fuel from the engine-driven fuel pump

C. AC electrical power supplied by the No. 1 or No. 2 inverter

D. Flow from the transfer ejector pump

8. If the engine-driven fuel pump fails:

A. The engine flames out.

B. The primary ejector pump fails also, but the boost pump energizes by low pressure and sustains the engine.

C. The transfer ejector pumps also is inoperative.

D. Crossfeed must be selected in order to obtain high-pressure motive flow from the opposite engine.

9. If crossfeed has been selected and normal DC electrical power is lost (battery switch in EMER with a dual generator failure):

A. The system remains in crossfeed.

B. The crossfeed valves fails to close.

C. Both boost pumps are energized to terminate crossfeed.

D. The motive-flow shutoff valve fails to open.

10. To use the SPPR system a precheck:

A. Is mandatory.

B. Consists of establishing stabilized fuel flow from the truck, then rotating the precheck levers straight out, with the totalizer showing zero fuel flow within 30 seconds.

C. That is unsuccessful means using overwing refuel and repairing the SPR system.

D. All of the above.

11. Maximum SPR refueling is limited to:

A. 60 psi

B. Any pressure

C. 105 gpm

D. A and C

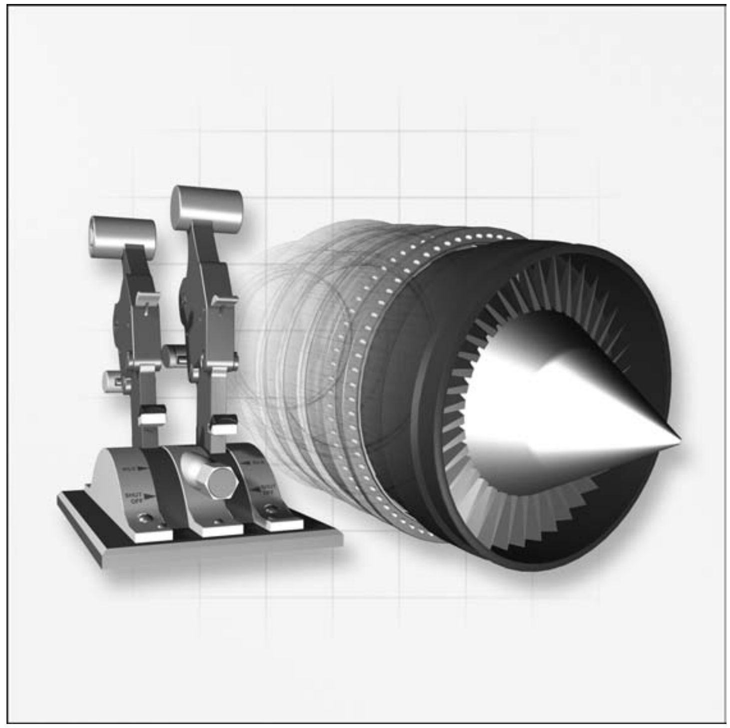
The information normally contained in this chapter is
not applicable to this particular airplane.

CHAPTER 7
POWERPLANT

CONTENTS

ILLUSTRATIONS

CHAPTER 7
POWERPLANT



INTRODUCTION

This chapter deals with the powerplant of the Citation V Ultra aircraft. In addition to the powerplant, this chapter also describes such related systems as engine oil, fuel and ignition, engine instrumentation, engine power control, engine starting, engine synchronization, and the thrust reversers.

GENERAL

Thrust is provided for the Citation V Ultra by two aft fuselage-mounted turbofan engines manufactured by Pratt & Whitney Aircraft of Canada Limited.

The engines are lightweight, twin-spool turbofans designated JT15D-5D. Each engine develops 3,045 pounds of thrust at sea level, flat rated to 80°F (27°C).

MAJOR SECTIONS

For the purpose of explanation, the engine is divided into six major sections (Figure 7-1):

- Intake and fan
- Compressor
- Combustion
- Turbine
- Exhaust
- Accessories

INTAKE AND FAN SECTION

This section includes the air intake and the fan assembly.

The air intake divides into two concentric ducts aft of the fan assembly. One duct forms a full length bypass air duct, and the other duct is the inlet air duct to the engine. A temperature probe called T_1 is in the intake air duct. It is anti-iced by bleed air whenever the engine is operating.

The fan assembly consists of a nose cone, a fan stage, a single-axial compression stage, and two sets of stator vanes. The nose cone is continuously anti-iced by engine bleed air whenever the engine is operating.

COMPRESSOR SECTION

The compressor consists of a low-pressure compressor and a high-pressure compressor.

The low-pressure compressor, consisting of the non-geared fan and booster stage, is an axial compressor unit functioning to compress and accelerate air rearward.

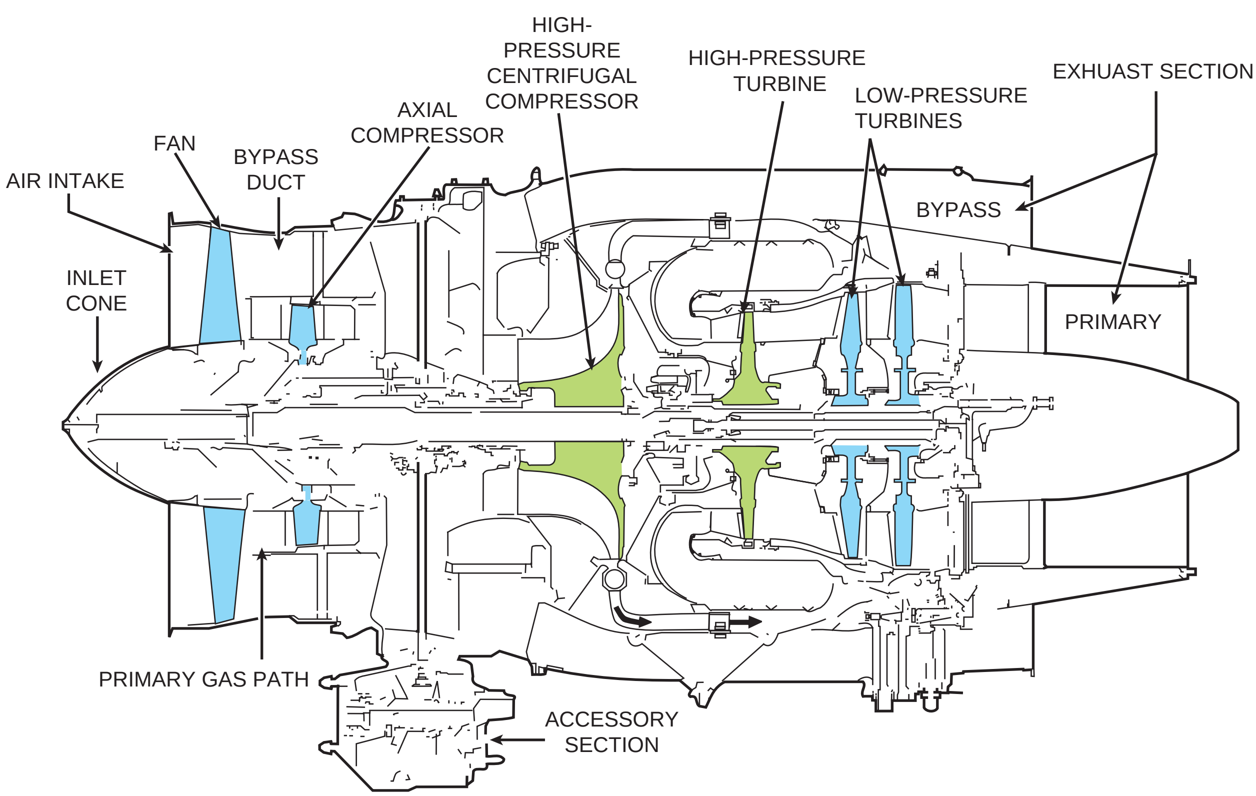


Figure 7-1. Major Sections

The outer span section of the fan stage accelerates a relatively large volume of air at a moderately low velocity into the fan duct. The inner section of the fan accelerates air rearward to the booster stage. This stage extends only into the primary air path and functions to increase air pressure and direct it to the high-pressure compressor.

The bypass ratio is the difference in air mass flow between the bypass duct and the engine core, which is approximately 2.1:1.

The high-pressure compressor is a single-stage centrifugal compressor which receives airflow under pressure from the booster stage. It further increases the pressure and directs the airflow rearward.

Bleed-Off Valve

The –5D engine incorporates a bleed-off valve between the axial booster and centrifugal compressors. Since the only link between the two spools of the engine is airflow, it is possible for a mismatch of spool speed to result in engine surging. This is most likely to occur at altitude during engine accelerations or decelerations. When the valve is opened, it allows some of the compressor air to dump into the bypass duct to increase the surge margin on the engine.

The bleed-off valve is operated by a controller inside the engine nacelle. It energizes the valve open, based upon altitude and engine N_2 speed. The controller receives N_2 speed via its monopole pickup and senses altitude at a sense port on the controller itself. The power for the system is from the LH or RH BOV circuit breakers on the left CB panel. In the event of DC power failure, the valve fails closed, and rapid engine accelerations and decelerations at altitude should be avoided.

COMBUSTION SECTION

This section consists of an annular reverse flow combustion chamber. A precise volume of the compressor airflow enters the combustion chamber. Fuel is added by 12 fuel nozzles, and the mixture is ignited by two igniter plugs. The expanding and accelerating gases are directed rearward to the turbine.

TURBINE SECTION

This section consists of a single high-pressure and two low-pressure turbines.

The high-pressure turbine is connected to the high-pressure compressor by a rotor shaft. The function of the high-pressure turbine is to extract sufficient energy from the expanding combustion gases to drive the high-pressure compressor and the accessory section.

The high-pressure compressor and turbine assembly form the high-pressure spool. The rpm of the high-pressure spool is designated N_2, or turbine.

The low-pressure turbine is two-stage. It is connected to the low-pressure compressor by a rotor shaft that runs through the high-pressure compressor rotor shaft. The function of the low pressure turbine is to extract sufficient energy from the combustion gases to drive the low pressure compressor and fan.

The low-pressure compressor and its turbine form the low-pressure spool. The rpm of the low pressure spool is designated N_1, or fan.

EXHAUST SECTION

This section consists of the primary exhaust duct and the bypass air duct. The primary exhaust duct includes a tapered cone and struts. The combination of primary exhaust and bypass airflow produces the total propulsive force for the aircraft.

ACCESSORY SECTION

The accessory section consists of a gear assembly encased on the underside of the engine. The accessory gear is driven by the high pressure rotor shaft through a tower shaft and bevel

gear. It functions to drive the following accessories:

- Oil pump
- Hydraulic pump
- Fuel control unit (FCU) and fuel pump
- Starter–generator

In addition to these accessories, a combination DC starter-generator is on the accessory gear case to provide the input for engine starting.

OPERATION

Air is directed from the nacelle inlet to the engine air intake (Figure 7-2). The outer span section of the fan compresses and accelerates a large volume of air at a low velocity into the full-length bypass duct.

Simultaneously, the inner span section compresses and accelerates a volume of air to the primary gas path axial compressor stage. Air pressure is increased by the booster stage and directed to the high-pressure compressor which accelerates the air mass and directs it through a diffuser. The diffusion process changes the velocity energy to pressure energy. A relatively small portion of the air enters the combustion chamber where fuel is added and ignition occurs. The combustion process produces expansion and acceleration. The rest of the compressed air is used to operate various bleed-air services on the aircraft and for internal cooling in the engine.

The high-pressure turbine extracts energy to drive its compressor and the accessory section.

The low-pressure turbine extracts energy to drive the low-pressure compressor (fan and booster). The remaining energy is directed into the exhaust section where it joins with the bypass airflow to provide thrust.

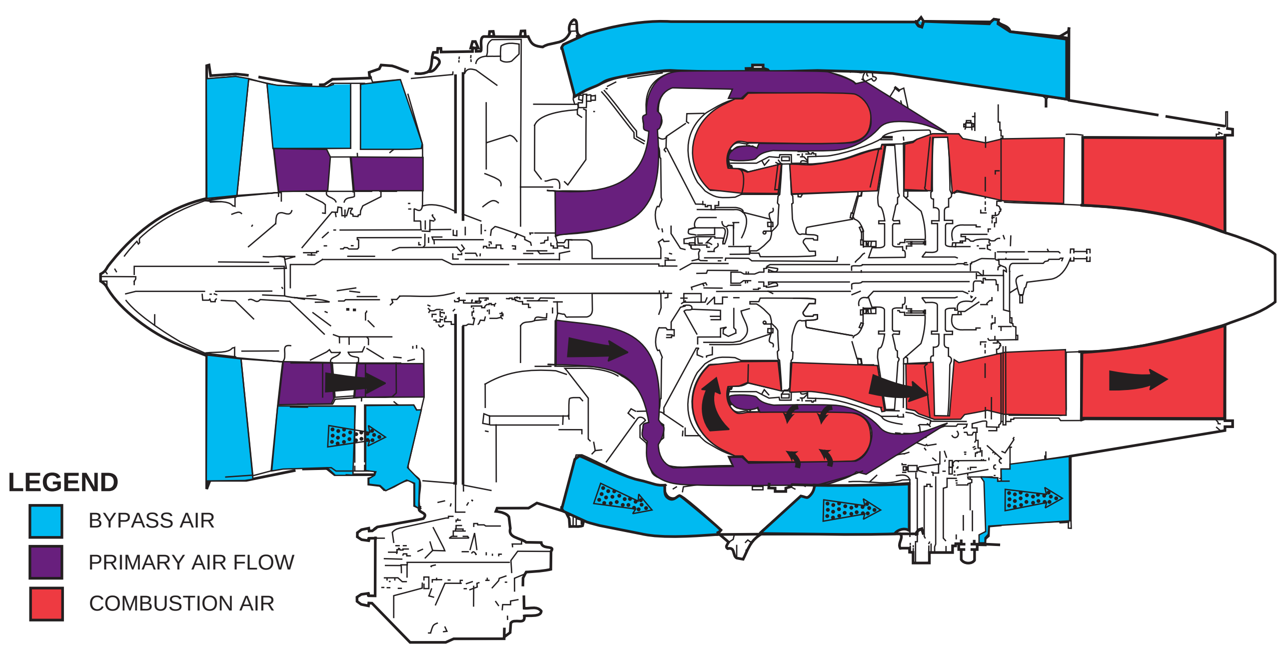


Figure 7-2. JT15D-5D Gas Flow

ENGINE SYSTEMS

The engine systems include the following:

- Oil system
- Fuel system
- Ignition system
- Instrumentation
- Power control
- Synchronization
- Thrust reversing

OIL SYSTEM

The oil system is fully automatic and provides cooling and lubrication of the engine bearings and the accessory section.

Oil Tank

The oil tank forms an integral part of the compressor intermediate case. An oil filler and dipstick assembly (Figure 7-3) is accessible for servicing and checking. Ensure that the dipstick is fully secured after checking. The oil quantity should be checked within 10 minutes after engine shutdown.

Figure 7-3. Oil Servicing Access

Oil Pump

An engine-driven three-in-one oil pump (including one pressure and two scavenge elements) provides for pressure lubrication and scavenging. It is mounted on the accessory section.

Oil Cooling

Oil temperature is maintained within limits by an oil-to-fuel heat exchanger.

Oil Filter

An oil filter with a bypass is used to remove solid contaminants from the fluid. However, there is no indication or annunciation of filter bypass occurring.

Oil Pressure

Engine oil pressure is maintained within limits by a mechanical relief valve.

Indication

Oil pressure is sensed by dual transmitters within the system. A pressure transducer sends the input to a dual vertical tape gauge on the center instrument panel (Figure 7-4). The gauge is calibrated in psi. A pressure switch activates an OIL PRESS WARN LH/RH light.

The oil pressure indicating system is powered from 28 VDC (the left gauge from the left extension bus and the right gauge from the right extension bus). A red OFF flag appears at the top of the gauge scale when DC power is not available to the gauge.

An oil pressure switch also senses oil pressure. The switch contacts closes and power a red OIL PRESS WARN LH or RH annunciator when oil pressure decreases below 40 psi.

Oil temperature is sensed by a resistance bulb, then transmitted to a dual-scale vertical tape gauge on the center instrument panel (Figure 7-4). The scales are calibrated in degrees

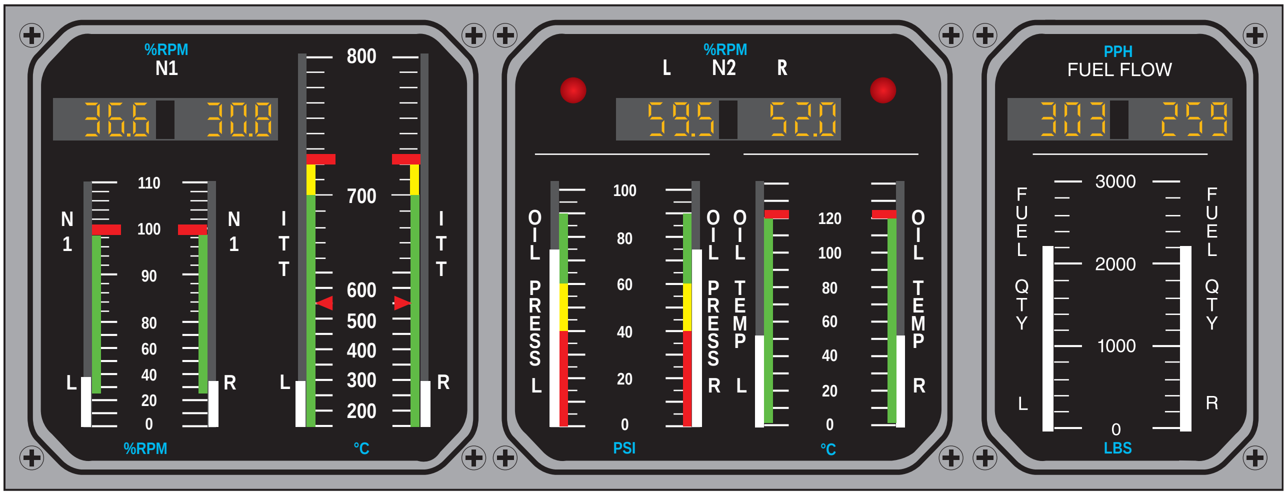


Figure 7-4. Center Instrument Panel

Celsius and require 28 VDC. A red OFF flag appears at the top of the scale when DC power is not available.

NOTE

Engine oils approved for use are listed in the Limitations section of the *Airplane Flight Manual (AFM)*. Normally, brands must not be mixed.

NOTE

The oil level should be checked as a post flight item. For a valid indication, the check should be done within 10 minutes after engine shutdown. The maximum allowable oil consumption is 1 quart every 4 hours measured over a 10-hour period.

Operation

Figure 7-5 illustrates the operation of the engine oil system.

FUEL SYSTEM

A hydromechanical fuel system supplies metered fuel for engine starting, acceleration, deceleration, and steady-state operation.

The fuel system includes an engine-driven pump, a fuel filter, a fuel control unit (FCU), a flow divider, an emergency shutoff valve, two fuel manifolds, and 12 equally spaced spray nozzles in the combustion chamber.

Fuel Pump

The fuel pump receives a fuel supply at fuel tank pump pressure and delivers a high-pressure fuel supply to the FCU. This pump is not a suction pump and must receive fuel under pressure from the wing tank. If this pump fails, the engine flames out since there is no other source of high-pressure fuel available to the engine.

Fuel Filter

A fuel filter with a bypass valve removes any solid contaminants from the fuel.

FCU

The FCU is hydromechanical and consists of a computing section, a governing section, and a metering section.

Five parameters are sensed by the computing section: (1) P_3 or compressor discharge pressure, (2) P_A or ambient pressure, (3) T_1 or

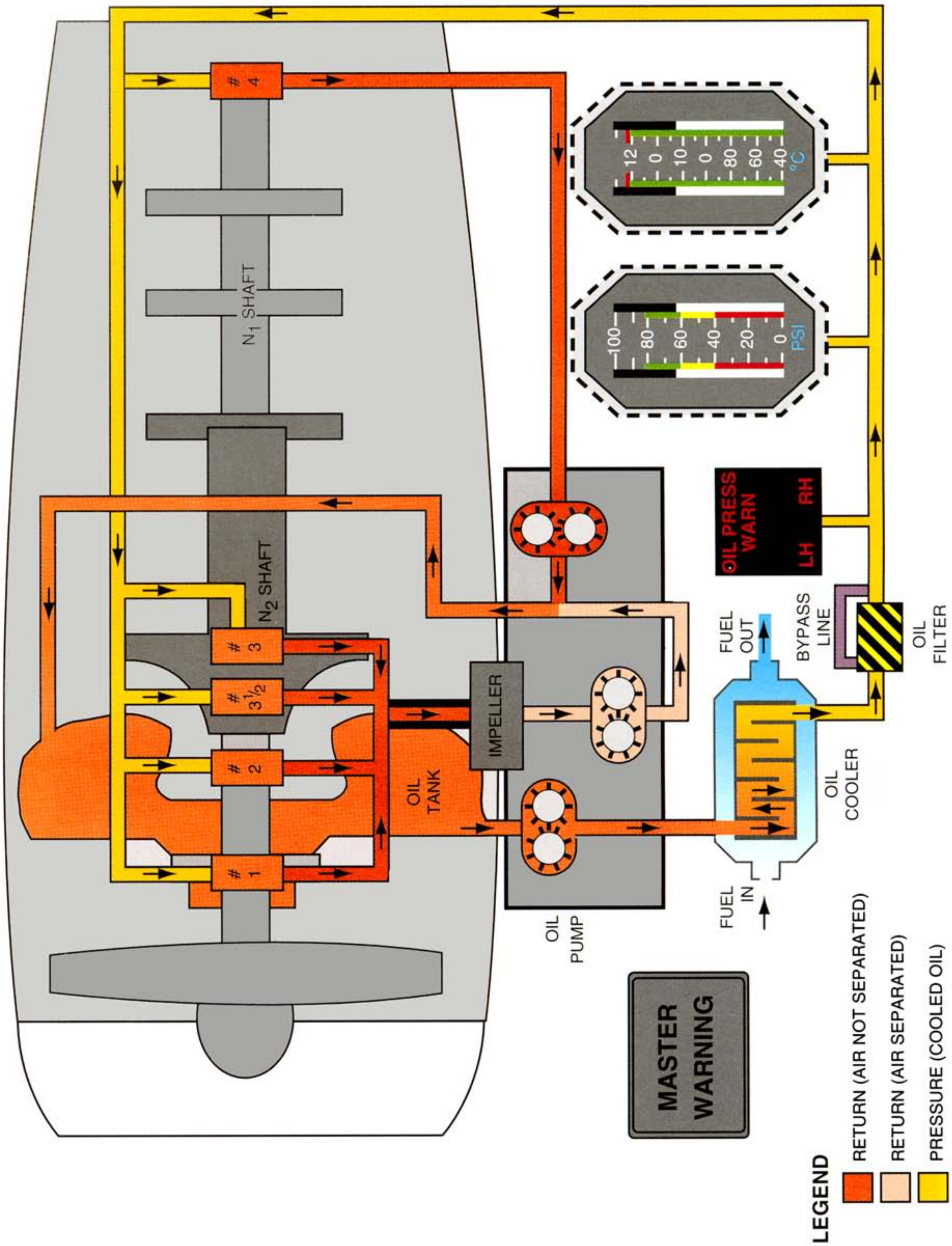


Figure 7-5. Oil System

compressor inlet temperature, (4) N_2 rpm, and (5) throttle position.

The governing section senses N_2 rpm and throttle position and modifies the signals transmit-ted by the computing section to the metering section. The resultant of these signals determines the position of the fuel metering valve and, consequently, the volume of fuel delivered to the combustion chamber.

Flow Divider

The flow divider functions to divide the metered fuel between a primary and a secondary manifold which supplies fuel to the spray nozzles. The flow divider also ensures against fuel flow to the nozzles until an efficient fuel pressure is present. During engine starting and low power settings, the flow divider directs fuel only to the primary nozzles. Fuel can be directed to both nozzles at higher power settings. A drain valve on the flow divider drains the residual manifold fuel into a fuel collector whenever the engine is shut down. The collected fuel is returned to the associated wing fuel tank during the subsequent engine start.

Emergency Shutoff Valve

The primary and secondary fuel supplies from the flow divider pass through a normally open emergency shutoff valve. This valve is operated mechanically by aft movement of the low pressure compressor rotor shaft beyond .070 inches. It automatically shuts the engine down if, for example, such movement is caused by failure of the low-pressure compressor rotor shaft, thus preventing an uncontrollable overspeed of the N_1 spool.

Fuel Spray Nozzles

Twelve duplex-type fuel spray nozzles form a precise atomized spray pattern that is conducive to complete combustion. The primary outlet supplies fuel for all operation. The secondary outlet, in conjunction with the primary, supplies fuel for higher power settings.

Indication

A flow meter senses metered fuel flow downstream of the FCU and displays fuel flow in pounds per hour on a dual LCD gauge on the center instrument panel (see Figure 7-4).

The power source for fuel flow indication is 28 VDC (the left gauge from the left extension bus and the right gauge from the right extension bus). The LCDs go blank when DC power is not available.

NOTE

Fuel flow indication is disabled when the associated throttle is moved to cutoff. This prevents erratic fuel flow indication when rpm decreases below 10%.

Operation

Figure 7-6 illustrates operation of the engine fuel system.

IGNITION SYSTEM

The Citation V ULTRA incorporates a dual high-energy ignition system consisting of two engine-mounted ignition exciter boxes, shielded cables, and two igniter plugs in the combustion chamber at the 5 and 7 o'clock positions.

Dual plugs provide redundancy only. One plug is sufficient to start or sustain the engine. With one igniter inoperative, the start is neither slower nor hotter.

Ignition operation is divided into automatic and selective phases.

Automatic ignition is available during engine starting. It is terminated automatically when the start sequence is terminated. Ignition also automatically activates when engine anti-ice is selected on.

Continuous ignition is accomplished by the pilot selecting ignition LH or RH.

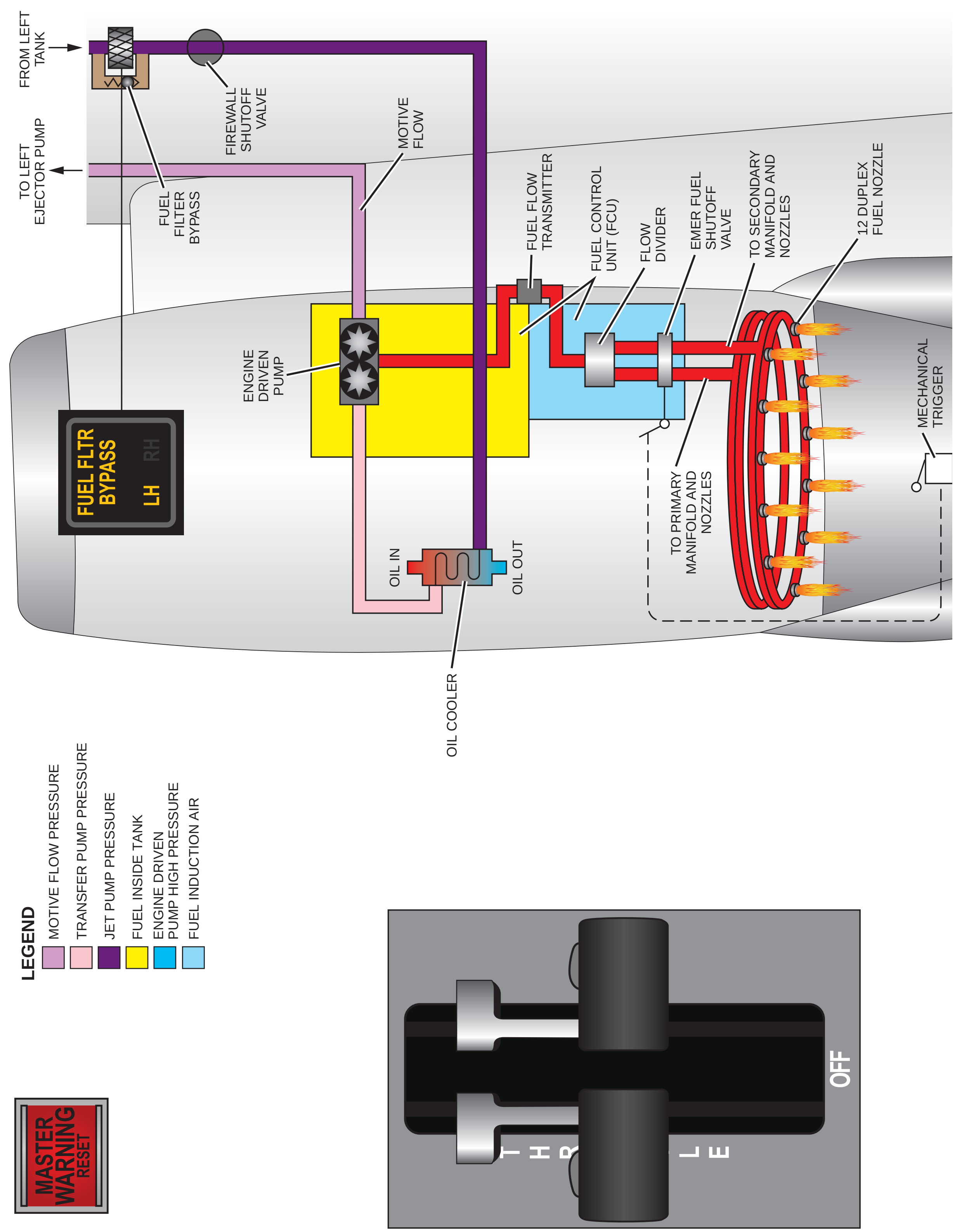


Figure 7-6. Fuel System

Control

The ignition system is controlled by a switch for each engine on the pilot switch panel (Figure 7-7). The IGNITION switch, on the pilot switch panel, has an ON and NORM position.

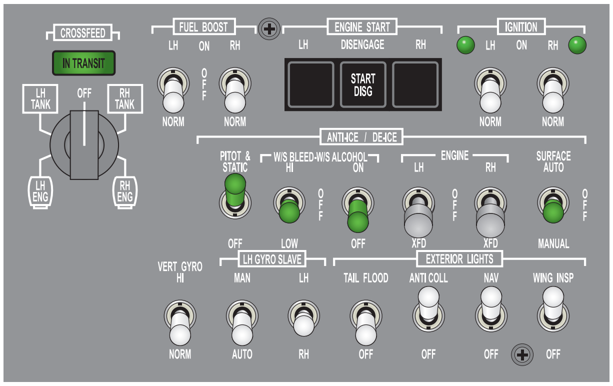


Figure 7-7. Pilot Switch Panel

When the IGNITION switch is at NORM, automatic ignition occurs during engine starting when the desired START switch (Figure 7-7) is pushed and the associated throttle is moved from the cutoff position (at 8% to 10% rpm). Ignition power, in this case, is supplied from the hot battery bus through a throttle-operated microswitch. Ignition and starter operation are both terminated by a speed-sensing switch on the starter-generator when engine self-sustaining speed is achieved.

Selecting the IGNITION switch to ON provides continuous ignition (for the selected engine) regardless of the position of the throttle. In this case, the left engine ignition power is supplied by the right crossover bus, and the right engine ignition power is supplied from the left extension bus.

When the IGNITION switch is at NORM, turning on an engine ANTI-ICE switch also provides continuous ignition for the selected engine (Figure 7-7). DC power is supplied from the hot battery bus during normal engine starts. Power is supplied from the left extension bus and right crossover bus for ignition ON and engine anti-ice ON.

NOTE

The IGNITION switch must be on for all takeoff and landing operations and during flight in heavy precipitation or turbulence, stalls, or during emergencies.

Indication

A green light near the IGNITION switch can be on whenever power is available to both ignition exciters (Figure 7-7). These lights do not indicate that the associated ignition exciter is operating or that the plug is firing.

Figure 7-8 illustrates operation of the engine ignition system.

INSTRUMENTATION

Instrumentation for the powerplant is provided by a horizontal row of gauges on the top of the center instrument panel (see Figure 7-4). From left to right these gauges are N_1 or fan rpm, Inter Turbine Temperature or ITT, N_2, or high-pressure compressor rpm (identified as turbine), oil pressure, and oil temperature.

N_1 (Fan) RPM

N_1 or fan rpm is supplied from a monopole pickup in the compressor case. The monopole consists of a coil of wire wound around a permanent magnet, positioned near the teeth of a gear on the low-speed or inner shaft. The monopole acts as an AC electrical generator, generating a voltage as the gear teeth move through its magnetic field. The output is displayed on a vertical tape on the dual-scale gauge (Figure 7-4), calibrated in percentage of rpm. A four-digit LCD display is also provided above each vertical tape.

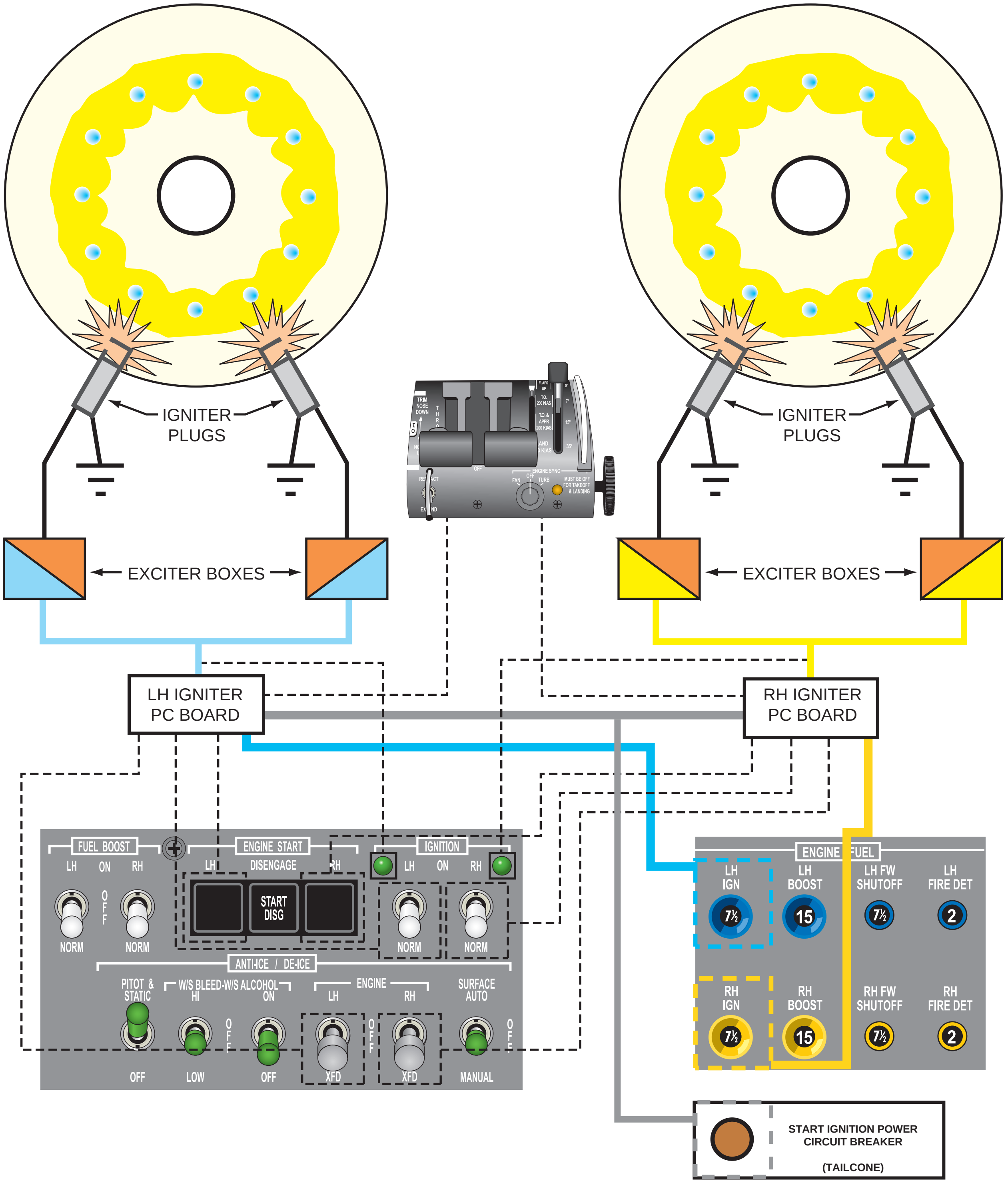


Figure 7-8. Ignition System

N_1 is the primary thrust indicator for the JT15D-5D engine. All engine power settings are made with reference to N_1.

The power supply for both N_1 instruments is from the emergency bus; therefore, both the vertical tape and the LCD display are available in the event of normal DC power failure.

ITT (Inter Turbine Temperature)

ITT for the JT15D-5D is a computed synthetic readout. Exhaust temperature is sensed by six thermocouples in the exhaust aft of the turbine. In addition, the temperature rise across the fan is sensed by two T_1 probes (one in front of the fan and one at the aft end of the bypass duct).

A trim resistor in the thermocouple system is test cell adjusted. The ITT readout is the resultant of adding three times the temperature rise in the bypass duct to the trimmed value of the thermocouple output. Consequently, this system provides an accurate indication of engine combustion temperature under all operating variables such as forward speed, altitude, and power setting. The computed temperature is displayed by vertical tapes (see Figure 7-4), and the scale is calibrated in degrees Celsius. LCD display is not provided. An OFF flag at the top of each scale is in view when electrical power is not available. The electrical power source is from the left extension bus for the left ITT, and the right extension bus for the right ITT.

Turbine N_2 (High-Pressure Compressor) RPM

Turbine or high-pressure compressor rpm is supplied by the accessory section and is displayed in percentage of rpm by dual LCD indications on the turbine gauge (see Figure 7-4) above the oil pressure/temperature gauges.

Power failure produces loss of the LCD display. A red light outboard each LCD readout come on (and, in conjunction, the digital display flashes) if N_2 rpm exceeds 97%. The power supply for the LCD displays is as explained earlier for ITT.

Oil Pressure

Refer to the Oil System section of this chapter.

Oil Temperature

Refer to the Oil System section of this chapter.

ENGINE POWER CONTROL

Engine power control is achieved by a throttle operating in a quadrant on the center pedestal. Throttle travel is from full aft or cutoff, through idle to full forward or maximum thrust position. A cutoff stop prevents inadvertent selection of cutoff. A latch on the throttle must be raised before the throttle can be moved to or from the cutoff position.

Thrust reverser control levers are piggyback on each throttle. The throttle is mechanically connected to a power lever on the fuel control unit.

Friction adjustment is provided for the throttle by a twist knob on the right side of the pedestal (Figure 7-9). Forward rotation increases friction as indicated by arrows on the knob.

Ground Idle System

The JT15D-5D engine incorporates a ground idle feature which reduces the engine idle rpm

Figure 7-9. Friction Adjustment Knob

for taxi operations. The system is only enabled on the ground by the left main gear squat switch.

The system is controlled by a two-position GND IDLE switch on the tilt panel (Figure 7-10). With the switch in NORM, a solenoid on the fuel control unit is energized to extend a plunger, which moves the fuel control unit linkage from the flight idle position (approximately 52% N_2) to ground idle (approximately 46% N_2). This is not accompanied by any throttle movement in the cockpit.

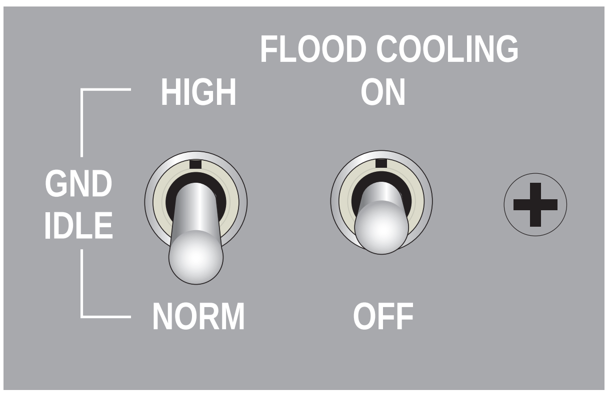


Figure 7-10. Ground Idle Switch

While NORM is enabled, the GROUND IDLE annunciator illuminates.

With the GND IDLE switch in HIGH, the solenoid is de-energized, and the plunger retracts away from the FCU linkage to allow the engine to return to flight idle.

There is always an 8 second delay whenever the system is activated. If the aircraft lands with the switch in NORM, the 8 second time delay relay does not allow the engines to roll back to NORM immediately in the event of a rejected landing. When the switch is placed to NORM with the aircraft already on the ground, the 8 second delay still does not allow immediate roll-back to low idle.

If the GND IDLE switch is in NORM during takeoff, full power can be attained as normal, but the GROUND IDLE light does not extinguish until the left main gear squat switch indicates that the aircraft is airborne.

The power source for the system is from the ENGINE SYNC circuit breaker on the left extension bus.

Engine Starting

Engine starting is divided into two general categories: ground starting and airstarting.

Ground starting is divided into battery starting, generator-assist starting, and external power unit (EPU) starting. air starting is divided into starter-assist airstart and windmilling airstart.

For a description of engine starting, refer to Chapter 2—"Electrical Power Systems."

All types of airstarts must be performed in accordance with the airstart envelope (Figure 7-11). For control and procedures for air starting, refer to Chapter 2—"Electrical Power Systems."

SYNCHRONIZING

The engines on the Citation V ULTRA incorporate a fan and/or turbine master slave rpm synchronizer, consisting of a synchronizer controller, an actuator, a control switch, and a light. The left engine is the master engine and the right engine is the slave. When selected, the system functions to adjust the rpm of the right engine to precisely that of the left engine. The system operates in a very narrow band to prevent serious spooldown of the slave engine caused by power loss or failure of the master engine.

Prior to engaging the synchronizer, the engines should be manually synchronized with the throttles to within 2.0%. When power changes are desired, the system should be turned off, the power adjustment made, and the system reengaged. The system must also be off during takeoff, approach and landing, and single-engine operation.

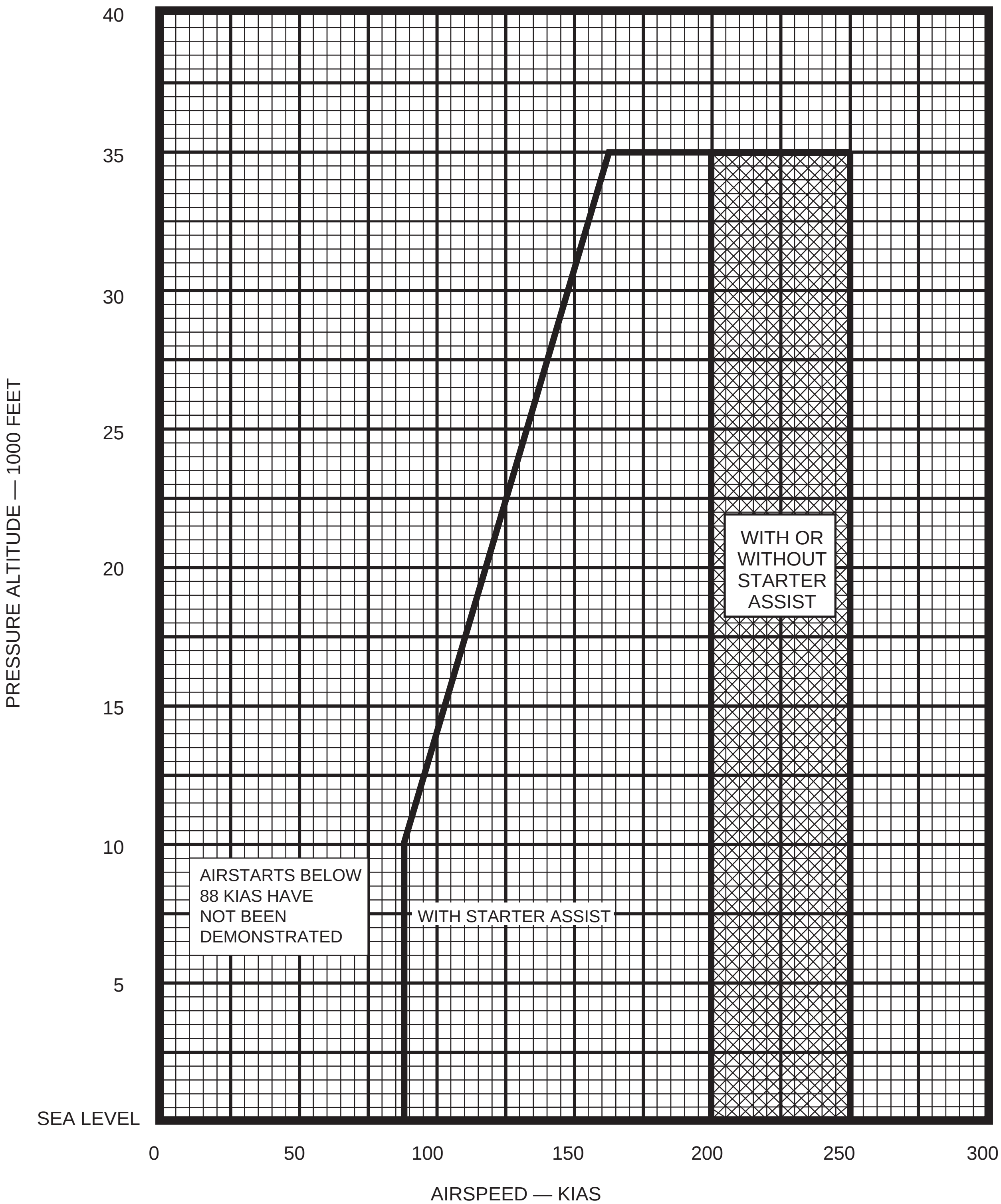


Figure 7-11. Airstart Envelope

The synchronizer functions to reduce the characteristic out-of-sync beat of turbine engines, consequently providing a quieter cabin for maximum passenger comfort.

Control

The engine synchronizer is controlled by a three-position ENGINE SYNC–FAN–OFF–TURB rotary switch (Figure 7-12). Turning the switch off permits the controller to run the actuator (in the right nacelle) to a null or center position.

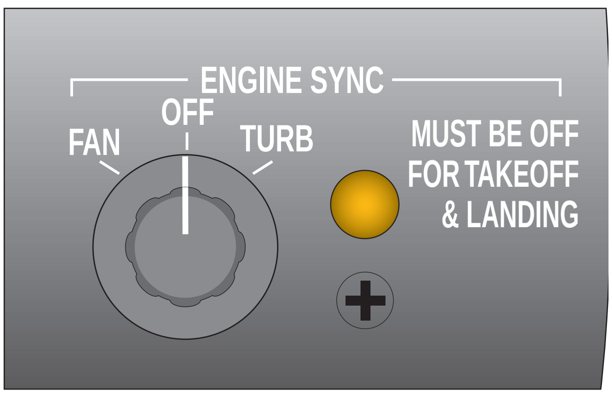


Figure 7-12. ENGINE SYNC Switch

Selecting FAN or TURB permits the controller to synchronize the left and right engine to fan or turbine rpm as selected.

Indication

When the ENGINE SYNC switch is at FAN or TURB position, an amber ENGINE SYNC light (Figure 7-12) illuminates.

The system is turned on by the pilot when desired after takeoff. The monopoles (turbine and fan) supply rpm signals to the sync controller. The controller computes the error difference of the selected (fan or turbine) inputs and transmits an output signal to the actuator in the right nacelle, which, in turn, adjusts the right FCU to synchronize the rpm to that of the left engine.

LIMITATIONS

For specific information on emergency/abnormal procedures, refer to the appropriate abbreviated checklists or the FAA-approved *AFM*.

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QUESTIONS

1. The primary thrust indicator for JT15D-5D is:
   A. Fuel flow
   B. N_1
   C. ITT
   D. N_2

2. If one igniter should fail during engine start:
   A. The engine starts normally.
   B. It results in a hot start.
   C. Combustion does not occur.
   D. The exciter box acts as a backup and the engine starts.

3. Ignition during normal engine start is activated by:
   A. Turning the IGNITION switches to ON at 8 to 10% N_2
   B. Moving the throttle to IDLE at 8 to 10% N_2
   C. Depressing the start button
   D. Nothing: Ignition is not needed during normal engine start.

4. Ignition during engine start is normally terminated by:
   A. Turning the IGNITION switches to OFF
   B. The speed-sensing switch on the starter-generator at approximately 38% N_2
   C. Turning the boost pump switch off
   D. Opening the ignition circuit breakers on the right-hand CB panel

5. Power can be automatically applied to the igniters when the IGNITION switch is in NORM anytime:
   A. The start button is depressed and the throttle is out of idle cutoff.
   B. The surface anti-ice system is activated.
   C. The engine anti-ice switch is on.
   D. Both A and C.

6. Of the following statements concerning the JT15D-5D engine, the correct one is:
   A. Fuel from the engine fuel system is used to cool the engine oil through a fuel-oil heat exchanger.
   B. The engine accessory gearbox has its own oil lubricating system (independent of the engine itself).
   C. The indication of low oil pressure is only the OIL PRESS WARN LH/RH annunciator light.
   D. Electrical power is not required to power the ITT instrument since it is self-generating.

7. The OIL PRESS WARN LH/RH light on the annunciator panel illuminates whenever:
   A. Oil temperature exceeds 121°C.
   B. Oil pressure is less than 40 psi.
   C. Oil filter clogs and bypasses oil.
   D. The fuel-oil heat exchanger becomes clogged.

8. The maximum allowable oil consumption for the JTl5D-5D engine is:
   A. 1 quart every 10 hours
   B. 1 quart every 4 hours (measured over a 10-hour period)
   C. 5 gallon every 40 hours (measured over a 10-hour period)
   D. No specified figure since it depends upon TBO

9. If the inner turbine shaft shifts to the rear greater than .070 inches:

A. The engine automatically shuts down.
B. The vibration detector causes illumination of the master warning lights.
C. The synchronizer shuts the engine down.
D. Nothing occurs.

10. The following engine instruments are available in the event of a loss of normal DC electrical power:

A. N_1 rpm and ITT
B. N_1 rpm, N_2 rpm, and ITT
C. N_1 rpm (tape and LCD display)
D. N_1 rpm (tape only)

11. The ENGINE SYNC switch:

A. Should be in FAN for takeoffs and landings
B. Should be in TURB at altitude
C. Can be placed in FAN or TURB after takeoff and should be left there for the remainder of the flight
D. Should be off for large power changes

CHAPTER 8
FIRE PROTECTION

CONTENTS

ILLUSTRATIONS

CHAPTER 8
FIRE PROTECTION

INTRODUCTION

The Citation V Ultra aircraft is equipped with engine fire detection and fire extinguishing systems as standard equipment. The systems include detection circuits which give visual warning in the cockpit and controls to activate one or both fire extinguisher bottles. There is a test function for the fire detection system. Two portable fire extinguishers are stowed inside the aircraft.

GENERAL

The engine fire protection system is composed of two sensing loops, two control units (one for each engine) in the tail cone, one ENG FIRE warning switchlight for each engine, two fire extinguisher bottles which are activated from the cockpit, and fire detection circuit test. The fire extinguishing system is a two-shot system; if an engine fire is not extinguished with actuation of the first bottle, the second bottle is available for discharge into the same engine. The fire bottles are in the tail cone of the aircraft. Abnormal ambient temperature also causes the bottles to automatically discharge through relief valves into the tail cone. Selected engine-related systems are automatically shut down upon activation of the fire protection system by the pilot.

ENGINE FIRE DETECTION AND INDICATORS

SENSING LOOPS AND CONTROL UNITS

Within each engine nacelle are two heat-sensing cables, or loops, one around the lower engine accessory section and one surrounding the engine combustion section. The sensing loops are flexible, stainless steel tubes containing a single wire centered in a semiconductor material. The loops are connected to control units that monitor their electrical resistance. As the loop is heated, its electrical resistance decreases until, at a temperature of 500˚F, a circuit is completed to the control unit to illuminate the applicable red ENG FIRE switchlight. The detection system is powered by normal DC supplied through the LH and RH FIRE DET circuit breakers on the right crossover and the left extension buses, respectively. Figure 8-1 shows the routing of the fire sensing loop and the control units.

ENG FIRE AND BOTTLE ARMED SWITCHLIGHTS

The red LH and RH ENG FIRE warning switchlights are on the glareshield (Figure 8-2). In the event of an engine fire or overheat condition, the applicable warning switchlight illuminates (although a red light, it does not trigger the MASTER WARNING lights). Pressing an illuminated ENG FIRE switchlight illuminates both white BOTTLE

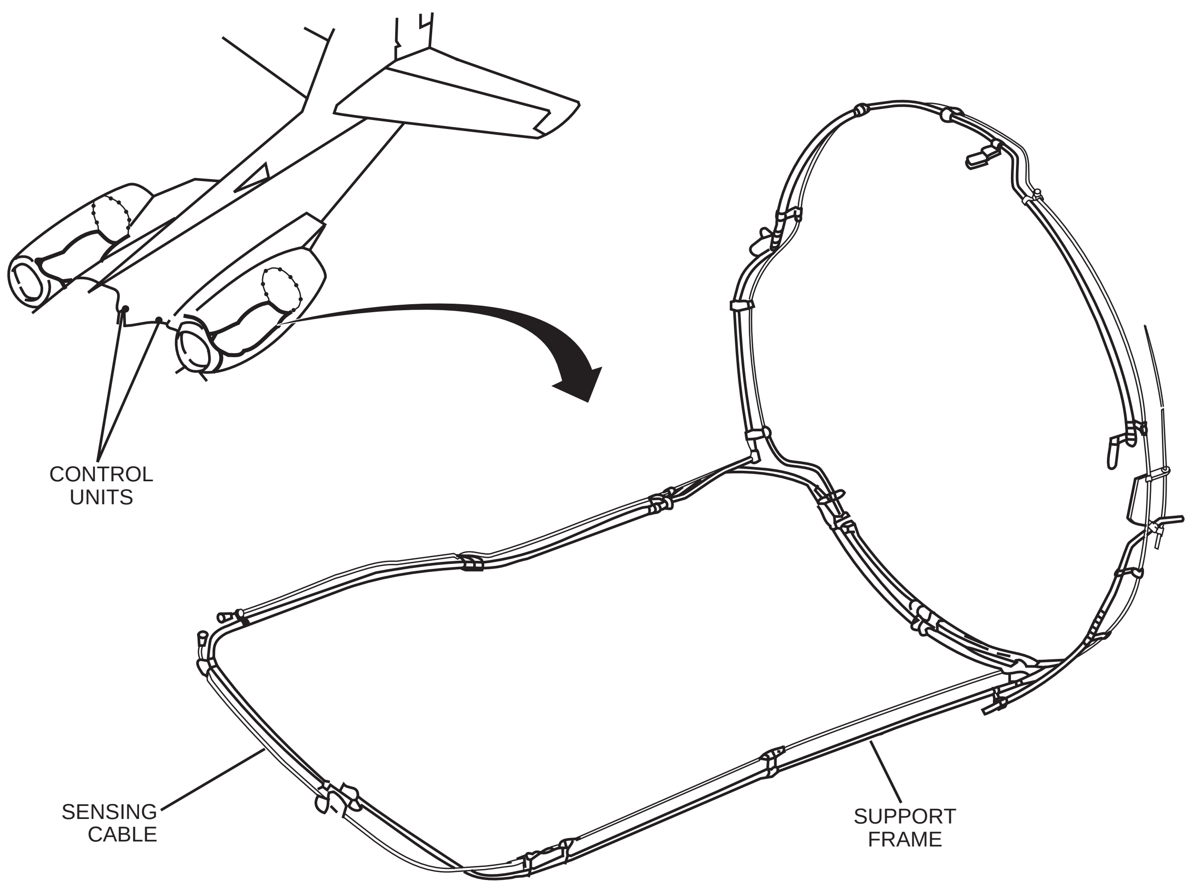

Figure 8-1. Engine Fire Detection System

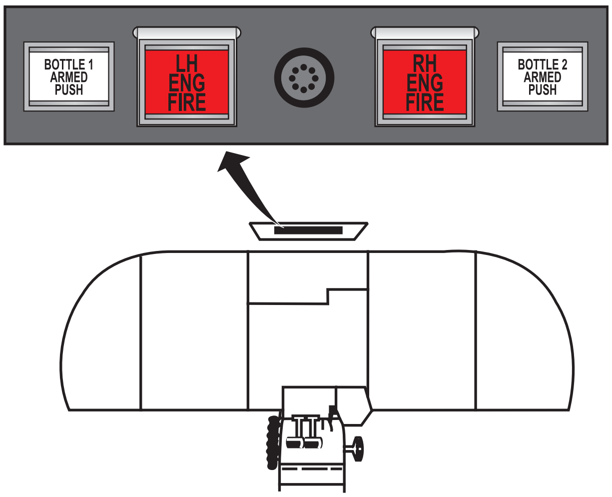

Figure 8-2. Fire Warning Switchlights and Controls

ARMED switchlights, which are the system actuating controls.

FIRE DETECTION SYSTEM TEST

The rotary test switch on the pilot instrument panel is used to test the fire detection system (Figure 8-3). When FIRE WARN is selected, both ENG FIRE switchlights illuminate.

ENGINE FIRE EXTINGUISHING

EXTINGUISHER BOTTLES

Two spherical extinguishing agent bottles are in the tail cone area (Figure 8-4). Both bottles use common plumbing to both nacelles, providing the aircraft with a two-shot system. The bottles are charged with monobromotrifluoromethane ($CBrF_3$) nitrogen pressurized to 600 psi at 70˚F. A pressure gauge is on each bottle with an adjacent temperature correction table. Bottle pressures are checked during the preflight inspection. The extinguishing agent is not corrosive, and its discharge does not necessitate cleaning of the engine or nacelle area

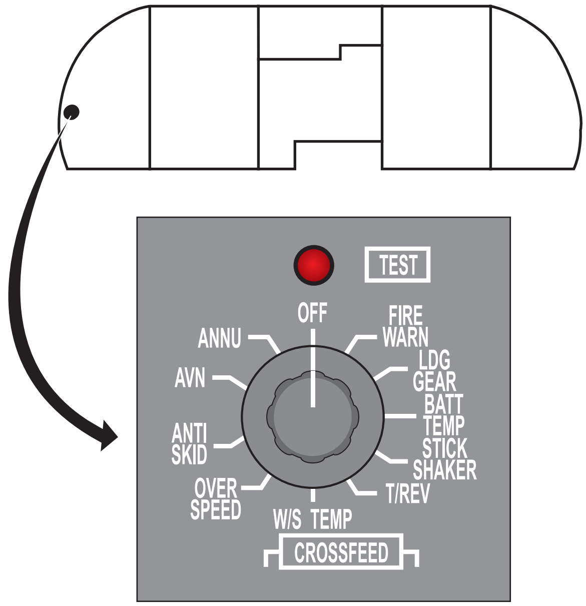

Figure 8-3. Rotary Test Switch

Figure 8-4. Engine Fire Bottles

since it leaves no residue. Release of the extinguishing agent is accomplished by the electrical firing of an explosive cartridge on the bottle.

The filler fitting on each bottle incorporates a fusible element that melts at approximately 210˚F ambient temperature, releasing the contents through the filler fitting into the tail cone.

OPERATION

An engine fire or overheat condition is indicated by illumination of the applicable ENG

FIRE switchlight on the glareshield (see Figure 8-2). After verifying that a fire actually exists, lifting the plastic cover and depressing the illuminated ENG FIRE switchlight causes both white BOTTLE ARMED switchlights to illuminate, arming the circuits to the bottles for operation. In addition, the fuel and hydraulic firewall shutoff valves close (respective FUEL LOW PRESS, HYD FLOW LOW, and F/W SHUT OFF annunciators illuminate), and the generator field relay is tripped (GEN OFF annunciator comes on). The circuit to the thrust reverser isolation valve is also disabled, preventing the deployment of the thrust reverser on that engine.

Depressing either illuminated BOTTLE ARMED switchlight fires the explosive cartridge on the selected bottle (Figure 8-5), releasing its contents into the engine nacelle. The BOTTLE ARMED switchlight goes out.

If the ENG FIRE switchlight remains on, indicating that the fire still exists, the remaining BOTTLE ARMED switchlight may be depressed after 30 seconds to release the contents of the remaining bottle into the same nacelle.

Detection and extinguishing system electrical power for the left engine is supplied by the right crossover bus. Power for the right engine systems is from the left main extension bus.

Depressing the ENG FIRE switchlight a second time opens the fuel and hydraulic shutoff valves and disarms the extinguishing system. The generator field relay is energized when the engine is restarted with starter assist. The thrust reverser isolation valve is re-enabled.

PORTABLE FIRE EXTINGUISHERS

Two hand-held fire extinguishers provide for interior fire protection. Both are 2 1/2-pound Halon 1211 extinguishers, charged with nitrogen to 125 psi. One of the extinguishers is under the copilot seat, the other one in the cabin (Figure 8-6).

COPILOT SEAT CABIN

Figure 8-6. Portable Fire Extinguishers

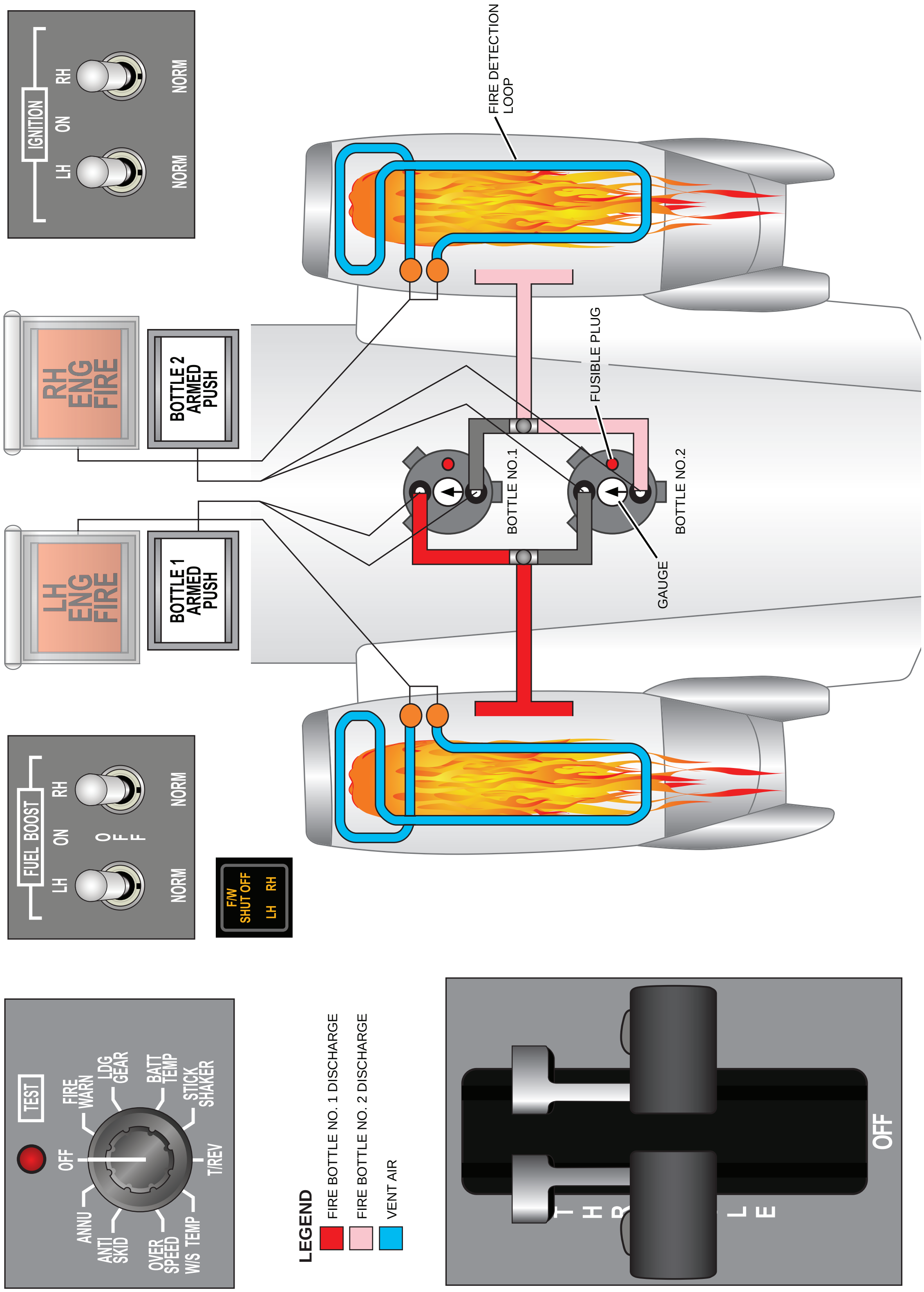

Figure 8-5. Engine Fire-Extinguishing System

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QUESTIONS

1. An ENG FIRE switchlight illuminates when:
   A. It is depressed.
   B. The MASTER WARNING lights illuminate for an engine fire.
   C. Temperature in the nacelle area reaches 500˚F.
   D. Electrical resistance of the sensing loop increases due to increasing nacelle temperature.

2. Depressing an illuminated ENG FIRE switchlight:
   A. Fires bottle No. 1 into the nacelle.
   B. Fires bottle No. 2 into the nacelle.
   C. Fires both bottles into the nacelle.
   D. Illuminates both BOTTLE ARMED switchlights, arming the system.

3. After a bottle has been discharged into a nacelle:
   A. No cleaning of the engine and nacelle area is required.
   B. A thorough cleaning of the engine and nacelle area is required.
   C. An inspection of the engine and nacelle area is required to determine if cleaning is necessary.
   D. None of the above.

4. When the fire-extinguishing system is armed for operation:
   A. The FUEL LOW PRESS light illuminates.
   B. The HYD FLOW LOW light illuminates.
   C. The GEN OFF light illuminates.
   D. All the above.

5. If the contents of a bottle has been discharged into a nacelle and the ENG FIRE switchlight remains on:
   A. The fire has been extinguished.
   B. The other bottle can be discharged into the same nacelle by depressing the other BOTTLE ARMED switchlight.
   C. The fire still exists, but no further action can be taken.
   D. The same BOTTLE ARMED switchlight can be depressed again, firing a second charge of agent from the same bottle.

6. Depressing the ENG FIRE switchlight a second time:
   A. Opens the fuel shutoff valve.
   B. Opens only the hydraulic shutoff valve.
   C. Resets the generator field relay.
   D. All the above.

CHAPTER 9
PNEUMATICS

CONTENTS

ILLUSTRATIONS

CHAPTER 9
PNEUMATICS

INTRODUCTION

The pneumatic system for the Citation V Ultra aircraft uses engine compressor bleed air. The air is extracted from both engines and routed through control valves into a pneumatic manifold for distribution to systems requiring pneumatic air for operation. In the event of single-engine operation, air from one engine is sufficient to maintain all required system functions. Safety devices are incorporated to prevent excessive pressure, and a control switch and condition indicating lights are integral parts of the instrument panel.

GENERAL

Bleed air from each engine is extracted from the engine high-pressure compressor section and routed to four different places:

- The flow control valves for use by the air cycle machine.
- The ground valve for use by the air cycle machine during ground operation.
- Through check valves for distribution to the windshield anti-ice, cabin door seal, and pressurization control systems.
- The emergency valve for alternate pressurization.

Control of airflow into the cabin area is accomplished with the PRESS SOURCE selector on the lower instrument panel just to the right of the pedestal. Sensors in critical areas of the air system cause illumination of annunciator lights on the main annunciator panel on the center instrument panel.

DESCRIPTION

DISTRIBUTION

Bleed air from each engine is routed to the associated welded cluster assembly, then on to three different places (Figure 9-1). Air from the cluster is routed through check valves to a ducting system that distributes the air to the windshield anti-ice system, the vacuum ejector, and the pneumatic distribution regulator. The regulator, in turn, distributes the air to the cabin door seal and deice boots. Air from the left engine cluster is routed to the emergency pressurization valve for distribution to the system mixing tube. The emergency pressurization valve can be opened only in flight because it is used to provide pressurization air should normal sources fail. Air from the right cluster is routed to the ground valve for use by the air cycle machine (ACM) during ground operation. The valve can be opened only on the ground and allows a larger draw of bleed air from the right engine for use by the ACM. Air from both clusters is routed through flow control shutoff valves and manifolded for use by the ACM.

CONTROL

The PRESS SOURCE selector determines the amount of air that enters the cabin and from what source it is supplied (Figure 9-2).

The control switch has OFF–GND–LH–NORMAL–RH–EMER position.

The OFF position closes all environmental bleed-air valves. The LH and RH flow control shutoff valves are energized closed by DC and the EMER valve is deenergized

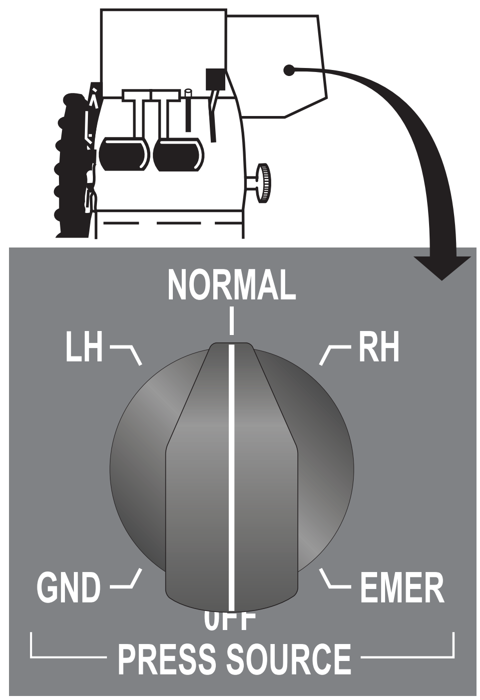

Figure 9-2. PRESS SOURCE Selector

closed. No air enters the ACM or pressure vessel from the engines. Bleed air is still available to the service air system, however. Ram air from the tail cone can enter the pressure vessel through the normal distribution ducting if the cabin is unpressurized.

The GND position of the PRESS SOURCE selector is functional only on the ground. It opens the ground valve and allows a larger mass flow of air from the right engine to enter the pneumatic manifold. When the valve is not fully closed, a BLD AIR GND light on the annunciator panel illuminates.

If the right engine is advanced above approximately 72% N_2, a primary pressure switch causes the ground valve to close, thus preventing too much air from being supplied to the ACM manifold and turbine. This action causes the BLD AIR GND light to extinguish. When the throttle is retarded below 72% N_2, the valve opens again, and the BLD AIR GND light reilluminates. If the primary pressure switch fails to close the valve, and the right

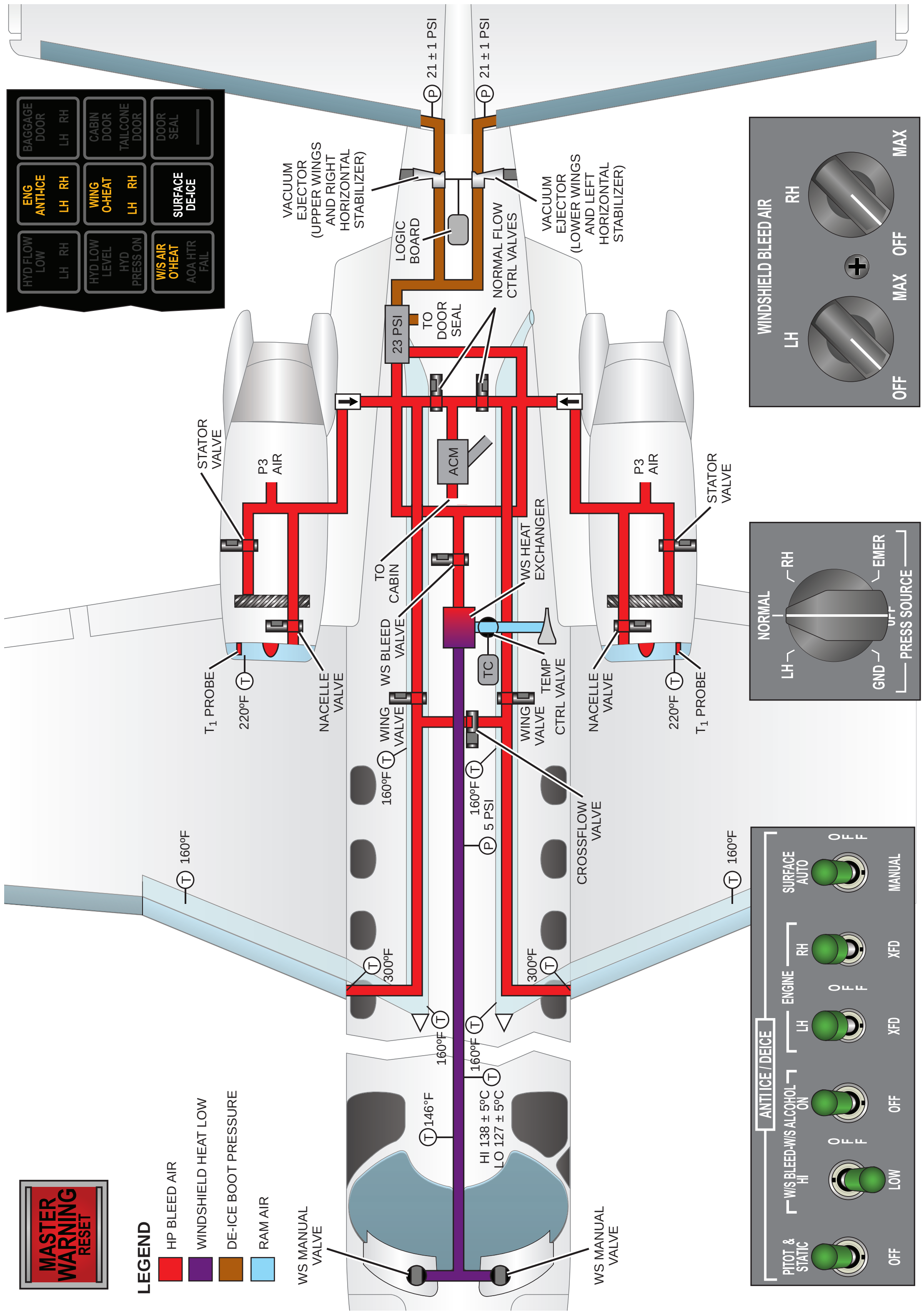

Figure 9-1. Pneumatic System Diagram

engine rpm exceeds approximately 74% N_2, the secondary pressure switch closes the ground valve and illuminates the ACM O'PRESS light. The ground valve does not open again until normal DC power is interrupted by removing power from the buses or by pulling the NORM PRESS circuit breaker.

The LH and RH positions limit pneumatic bleed-air input, to the engine associated with the selected switch position. The LH position allows use of air from the left engine and shuts off air from the right engine. With the RH position selected, the process is reversed.

The NORMAL position opens the left and right flow control valves and allows bleed air from both engines to pass through into the bleed-air manifold, then into the ACM. The valves fail to the NORMAL position if normal DC power is lost; all takeoff performance data is based on this position.

When the EMER position is selected in flight, bleed air from the left engine is routed directly into the cabin, bypassing the ACM. Temperature and volume are varied with the left throttle.

If a complete DC electrical power failure occurs, regardless of the PRESS SOURCE selector position, the pneumatic air is supplied as if the switch were positioned to NORMAL. Without electrical power, the emergency pressurization valve fails closed, and the two flow control and shutoff valves fail open. If selected, the GND valve (motorized) fails where it was when power was lost.

QUESTIONS

1. The source of bleed air for cabin pressurization when the EMERG PRESS ON light is illuminated in the air is:

A. Either the left or right engine
B. The left engine only
C. The right engine only
D. Ram air

2. The systems that use pneumatic bleed air for operation are the:

A. Emergency brakes and entrance door seal.
B. Surface deice, thrust reversers, entrance door seal, and ACM.
C. Entrance door seal, ACM, and thrust reversers.
D. Entrance door seal and ACM.

3. The flow control valves, when open, allow engine bleed air to operate the:

A. ACM
B. Windshield anti-ice
C. Entrance door seal
D. All of the above

4. The entrance door seal air is supplied by:

A. Regulated bleed air from the right engine only.
B. Regulated bleed air from the left engine only.
C. Regulated bleed air when either engine is operating.
D. Regulated ram air.

CHAPTER 10
ICE AND RAIN PROTECTION

CONTENTS

ILLUSTRATIONS

CHAPTER 10
ICE AND RAIN PROTECTION

INTRODUCTION

The Cessna Citation V Ultra aircraft is equipped with both anti-icing and deicing systems. The aircraft is approved for flight into known icing conditions when the equipment is functioning properly. These systems should be checked prior to flight if icing conditions are anticipated.

Anti-icing systems are incorporated into the wing, engine components, windshield, and pitot-static and angle-of-attack systems. These systems should be activated prior to entering icing conditions.

The deicing system consists of pneumatic boots on the wings and horizontal stabilizers.

GENERAL

Engine compressor bleed air is utilized to prevent ice formation on the T1 temperature probe, nose cone, nacelle inlet, and first set of stator vanes of each engine. Electrically operated valves, controlled by a switch on the pilot switch panel, control the flow of bleed air to the inlet duct and stator vanes of each engine. The T1 probe and nose cone are anti-iced continuously during engine operation.Additionally, bleed air is utilized to anti-ice the inboard section of each wing.

Engine bleed air is discharged through nozzles in front of the windshield for anti-ice protection of the windshield. Isopropyl alcohol is available for anti-icing of the left windshield in the event that bleed air is unavailable. Rain removal is provided by deflecting air away from the windshield via a set of doors.

Figure 10-1 illustrates the ice-protected surfaces on the aircraft.

ANTI-ICE SYSTEMS

PITOT AND STATIC ANTI-ICE SYSTEM

The PITOT and STATIC anti-ice switch (Figure 10-2) controls power to the pilot and copilot pitot tube heaters, the upper and lower pilot and copilot static ports (one on each side of the fuselage, below the cockpit) and the angle-of-attack probe heater. It also powers the standby pitot tube just below and ahead of the escape hatch and its two middle static ports on each side of the fuselage. The power to operate the system is from the left extension bus for the pilot pitot and static heaters and the angle-of-attack probe heater and from the right crossover bus for the copilot pitot and static heaters. The power to operate the standby pitot and static port heaters is from the emergency bus, through the STBY P/S HTR/VIB circuit breaker on the left circuit-breaker panel. The single PITOT and STATIC anti-ice switch controls power for the entire pitot-static anti-ice systems and the AOA anti-ice system.

Failure of the system is indicated by illumination of the P/S HTR OFF LH/RH annunciator if either pitot head or any of the four crew static port heaters fail. If the angle-of-attack probe heater fails, only the AOA HTR FAIL annunciator illuminates.

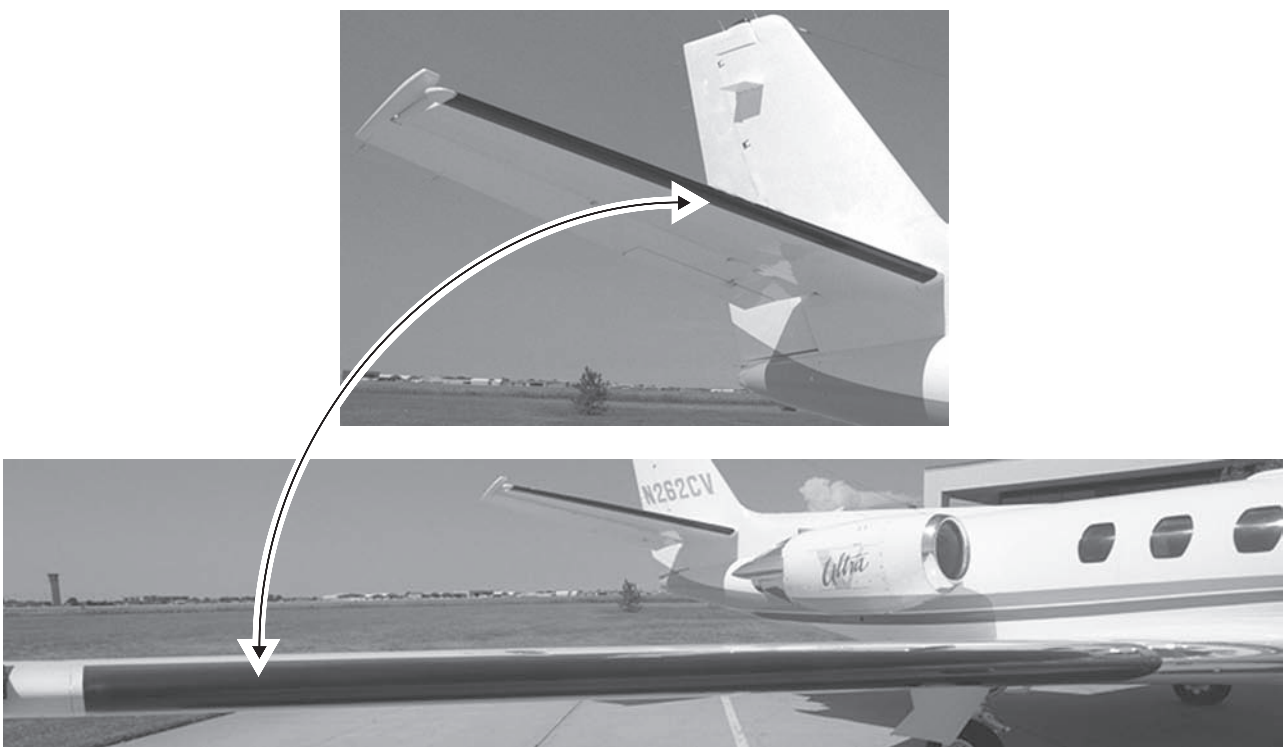

Figure 10-1. Ice-Protected Surfaces

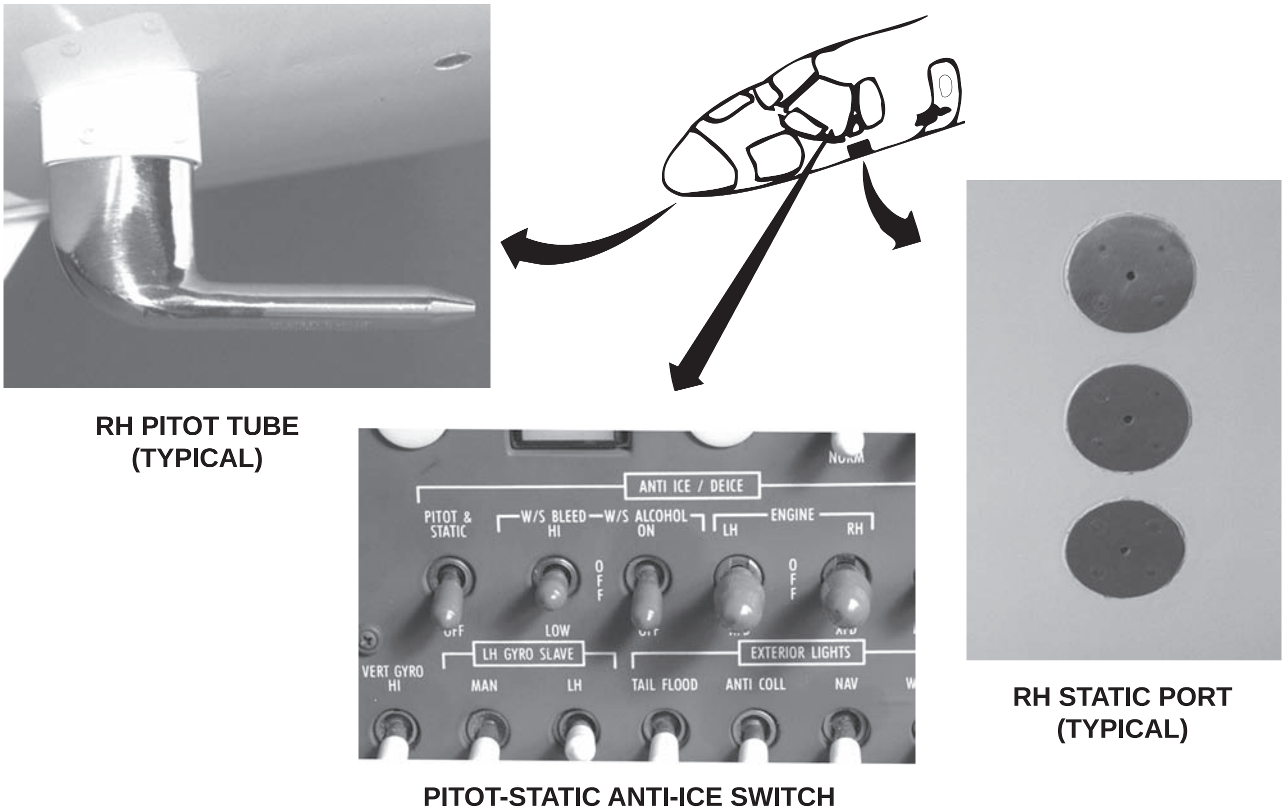

Figure 10-2. Pitot-Static Anti-Ice Components

A failure of the standby pitot head or any of its two standby static port heaters illuminates only the STBY P/S HTR OFF annunciator. Three annunciators are on if the pitot-static switch is OFF (P/S HTR OFF LH/RH, STBY P/S HTR OFF, AOA HTR FAIL).

CAUTION

Limit ground operation of the pitot-static heater system to two minutes to preclude damage to the pitot-static and angle-of-attack probe heaters.

TAS TEMPERATURE PROBE

A Rosemont TAS temperature probe (Figure 10-3) is on the right side of the nose area to provide temperature input to the two AZ-850 micro air data computers. Power is supplied from the left extension bus, through the TAS HTR circuit

Figure 10-3. TAS TEMP Probe

breaker on the left circuit-breaker panel. The probe is anti-iced only in flight with the avionics master switch ON. There are no warning lights associated with this system.

WINDSHIELD ANTI-ICE AND RAIN REMOVAL

The windshield may be anti-iced by use of engine bleed air or by alcohol in the event that the bleed-air system fails. The bleed air to the windshield is controlled by a W/S BLEED switch on the pilot switch panel and two manually operated WINDSHIELD BLEED AIR valves with knobs on the copilot instrument panel.

The switch has a HI, OFF, and LOW position. The control knobs open and close shutoff valves, modulating the amount of bleed air going to the windshield. The windshield anti-ice controls are shown in Figure 10-4.

The windshield anti-ice system (Figure 10-5) is activated by placing the W/S BLEED switch to either HI or LOW. This action deenergizes a solenoid-operated bleed-air valve and activates a temperature controller. The bleed-air valve, when deenergized, opens to allow hot engine bleed air to flow into the duct.

The air temperature controller automatically maintains a windshield bleed-air temperature of 138 ± 5˚C in the HI position and 127 ± 5˚C in the LOW position by modulating ram air through a heat exchanger. The controller receives three inputs: the position of the W/S BLEED switch and input from each of the two temperature sensors in the bleed-air line.

The signal generated by the temperature controller is transmitted to the motor-operated air control valve, which controls the amount of ram air that passes through a heat exchanger. Ram air passes across the heat exchanger, cooling the bleed air; then it exhausts overboard through a vent on the left side of the fuselage, forward of the tail compartment access door. The cooled engine bleed air is then directed onto the windshield through a series of nozzles.

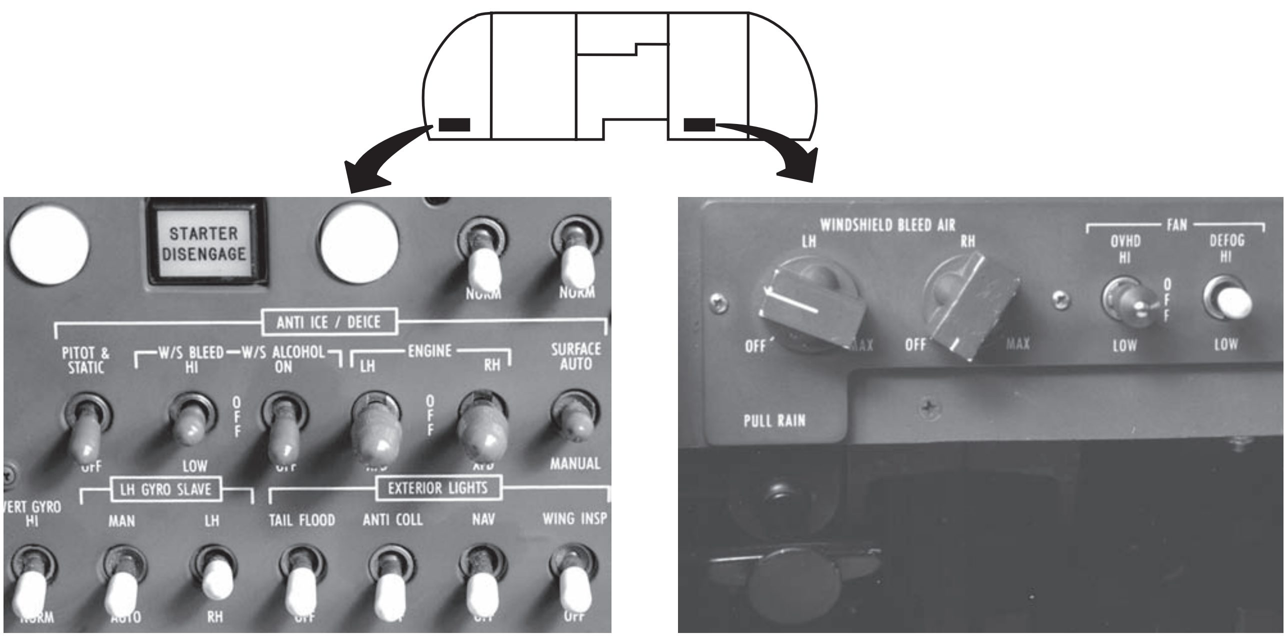

Figure 10-4. Windshield Anti-Ice Controls

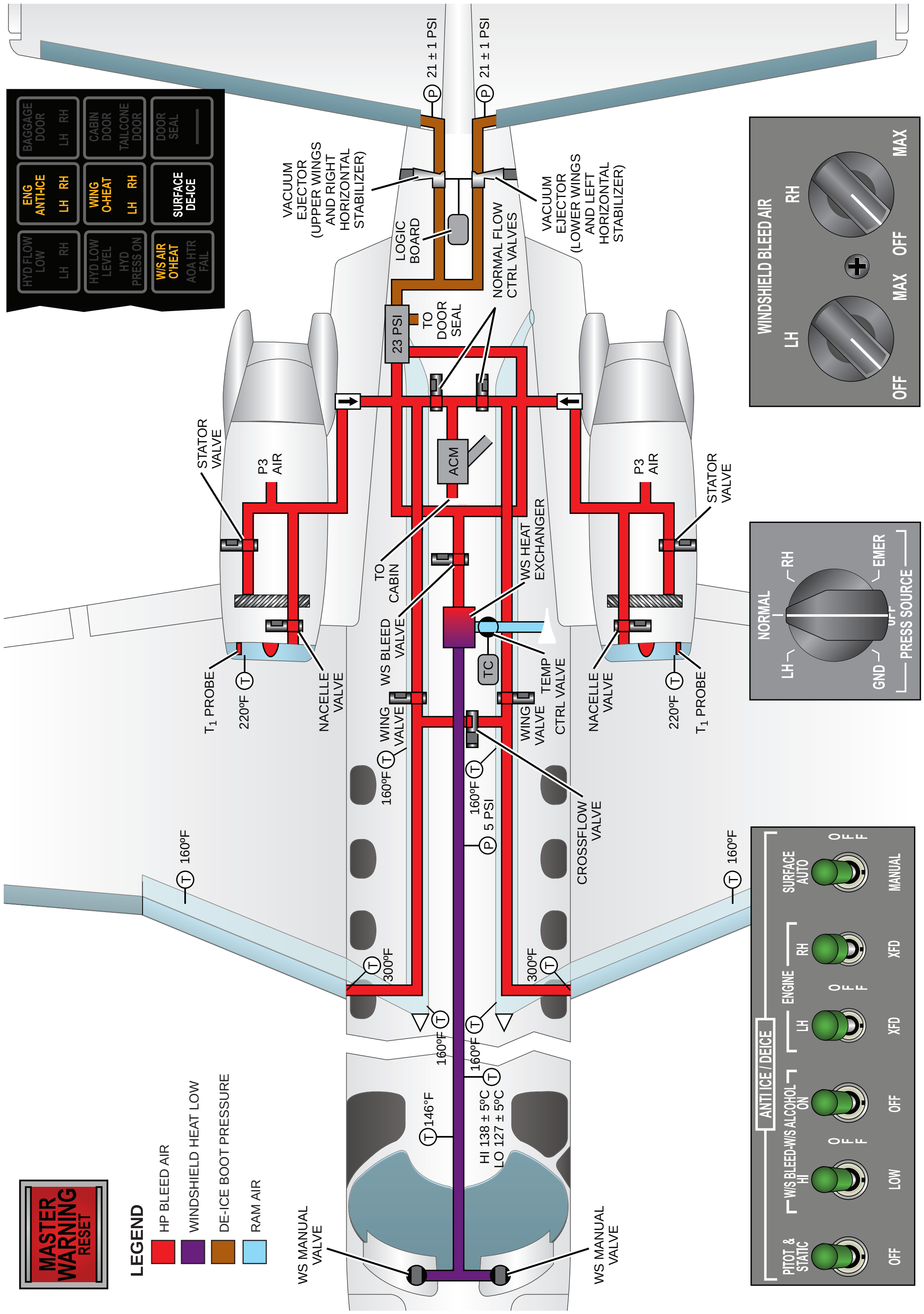

Figure 10-5. Windshield Anti-Ice and Alcohol System

When windshield anti-icing is required, the manual WINDSHIELD BLEED AIR valves are opened, and the W/S BLEED switch is selected to LOW if the OAT is above –18˚C or to HI if the OAT is –18˚C or below. Normal system operation is indicated by an increase in air noise as the bleed air discharges from the nozzles.

An additional temperature sensor is in the bleed-air duct, which automatically energizes the electrical solenoid bleed-air valve closed and illuminates the W/S AIR O'HEAT annunciator if the bleed-air temperature exceeds 146˚ C.This condition should not occur unless a sustained high-power, low-airspeed condition is maintained or a system malfunction occurs. The overheat sensor also automatically reopens the windshield bleed-air solenoid valve and extinguish the annunciator as the system cools.

If the overheat light illuminates, the WINDSHIELD BLEED AIR valves should be partially closed to reduce air flow.

If the W/S BLEED switch is in the OFF position and the W/S AIR O'HEAT annunciator illuminates, the bleed-air valve may have failed, and the pressure in the duct is sensed via a pressure switch. The pilot should ensure the WINDSHIELD BLEED AIR valves are positioned to OFF. This condition is not an overpressure situation, the pressure switch simply monitors the valve for a not fully closed condition when the switch is off. Sixty seconds after the W/S BLEED switch is off, the ram-air control valve is positioned fully closed.

If DC electrical failure occurs, the windshield bleed-air solenoid valve opens, and hot engine bleed air is available to the windshield. With an electrical power failure, the automatic temperature control and the overheat warning are inoperative, but if the manual control valves are open, the noise level increases as bleed air flows through the nozzles. The aircraft is normally flown with the manual valves closed; they are opened only when bleed air to the windshields is desired.

This procedure protects the windshield from inadvertent application of hot bleed air and possible damage in the event of an electrical power loss or failure of the bleed-air solenoid valve.

The windshield anti-ice system is tested before starting engines by positioning the warning and test switch to W/S TEMP and placing the W/S BLEED switch to either HI or LOW. When this is done, a windshield overheat condition is simulated, and the W/S AIR O'HEAT annunciator illuminates. Both the HI and LOW positions of the W/S BLEED switch should be tested for proper operation.

Windshield Alcohol System

The backup windshield anti-ice system consists of an alcohol reservoir, pump, and nozzles to provide up to ten minutes of continuous alcohol anti-ice capability for the pilot windshield only. The sight gauge for the alcohol reservoir is in the right nose baggage compartment, and the nozzles are shown in Figure 10-6.

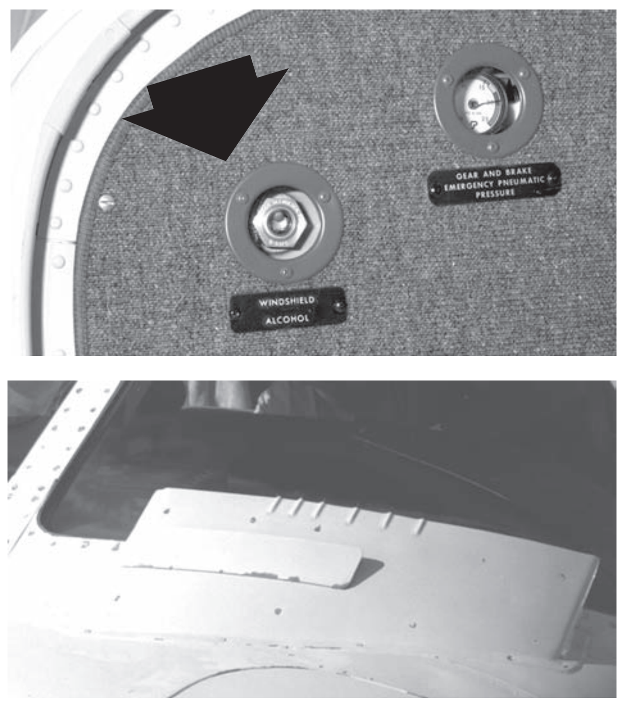

Figure 10-6. Alcohol Sight Gauge and Nozzles

The capacity of the alcohol reservoir is two quarts, and it uses an isopropyl alcohol-based fluid (TT-I-735). The system is designed to be used in the event the windshield bleed-air anti-ice system fails. It is controlled by the W/S ALCOHOL switch (see Figure 10-4), which has positions of ON and OFF. The electrical power source is the right crossover bus through the W/S ALCOHOL circuit breaker on the left circuit-breaker panel.

Rain Removal System

The rain removal system utilizes the normal bleed-air anti-ice system for rain removal, with rain doors to provide deflected airflow over each windshield in heavy rain. The doors are manually operated by pulling the PULL RAIN handle under the WINDSHIELD BLEED AIR knobs on the copilot panel. The rain removal doors and the PULL RAIN handle are depicted in Figure 10-7.

For rain removal, the WINDSHIELD BLEED AIR knobs on the copilot control panel should be rotated to the MAX position, the PULL RAIN handle pulled out, and the W/S BLEED switch positioned to LOW. Rain door opening is difficult if the windshield bleed air is already flowing out of the nozzles. To increase airflow to the pilot windshield during periods of low-power settings, such as during landing flare, rotate the copilot WINDSHIELD BLEED AIR knob to the OFF position. This diverts all available bleed air to the pilot windshield. In addition, the use of an approved rain repellent agent applied to the windshield before flight greatly enhances the effectiveness of the rain removal system.

ENGINE ANTI-ICE SYSTEM

The engine anti-ice system is a preventive system. Use of the system should be anticipated and the system activated when flight into visible moisture is imminent with indicated RAT is 10˚C or below. Failure to switch on the system before ice accumulation has begun may result in engine damage due to ice ingestion. For sustained ground operation in visible moisture at the above temperatures, position the ground idle switch to HIGH and

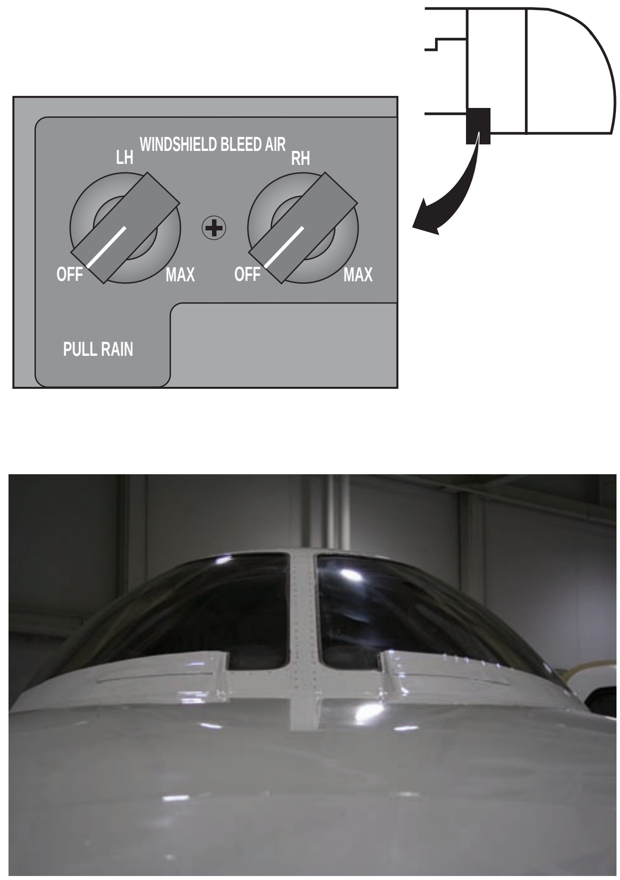

Figure 10-7. Rain Removal Doors and Control

engine left and right anti-ice systems ON. Operate the engines 1 out of every 4 minutes at 65% turbine rpm or above. The system consists of the bleed-air-heated portion of the wing leading edges, the nacelle inlet, and stator guide vanes (Figure 10-8).

With an engine operating, hot bleed air flows continuously to the nose cone and T_1 temperature probe in front of the fan in the engine inlet. Two other portions of the engine anti-iced by bleed air are the nacelle inlet and the first set of stator vanes behind the fan.

With operating engines, positioning the ENGINE ANTI-ICE switches ON, activates the engine anti-ice system (see Figure 10-4). With throttles advanced above the 63% N_2 microswitch position, electrical power is applied

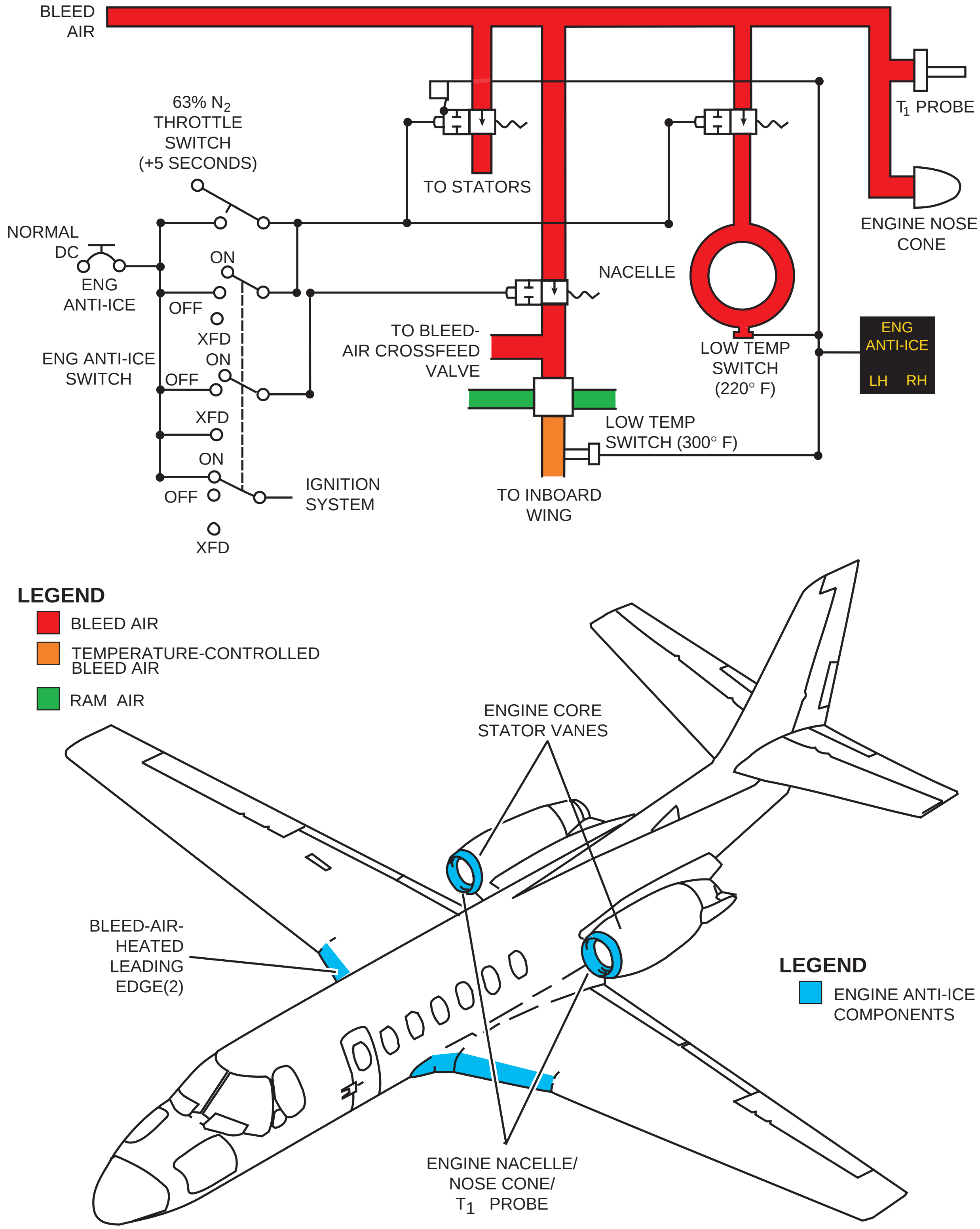

Figure 10-8. Engine Anti-Ice System

to a thermal 5 second time delay relay. Five seconds later the nacelle inlet and stator bleed-air valves deenergize open, allowing bleed air to flow to the nacelle inlet and stator vanes. Opening of the solenoid valves is indicated by an ITT rise and an rpm drop.

With the throttles above 63% N_2 rpm for *more* than five seconds, positioning the ENGINE ANTI-ICE switches ON deenergizes both solenoid valves, open immediately.

The engine anti-ice system is deactivated either by positioning the ENGINE ANTI-ICE switches OFF or by reducing the throttle setting below the 63% N_2 rpm microswitch position.

The ENGINE ANTI-ICE switches also activate the engine ignition ON.

WING ANTI-ICE SYSTEM

Turning on the engine anti-ice switches deenergizes the wing anti-ice valves open allowing hot bleed air from each engine to heat the 61” diffuser wing anti-ice panel in front of that engine (see Figure 10-8).

Unlike the nacelle inlet and stator valves, that are always closed below 63% N_2, the wing anti-ice valves are continuously open when the engine anti-ice switches are on. The panels are heated continuously on the ground and inflight regardless of throttle rpm. Increasing rpm increases available heat to anti-ice the panels.

Opening a wing anti-ice valve feeds hot engine bleed air forward through a hot-air duct surrounded by the ram-air cooling shroud to heat the wing anti-ice panel. The diffuser (piccolo) tube in the wing anti-ice panel directs the bleed air forward where an extension channels the bleed air against the leading-edge skin (Figure 10-9). The air then exhausts overboard through two lower, outboard vents (Figure 10-10).

The ram air cooling shroud provides temperature control of hot engine bleed air. An NACA scoop near the forward wing root fairing

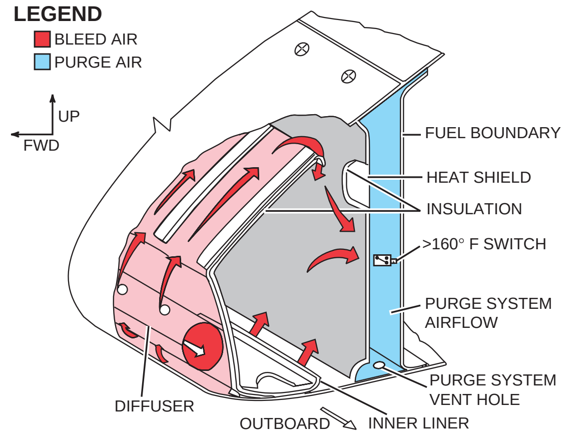

Figure 10-9. Wing Anti-ice Panel Cutaway View

Figure 10-10. Bleed-Air-Heated Leading Edge

Figure 10-11. Ram-Air Inlet

(Figure 10-11) provides cool ambient ram-air flow aft through the shroud to extract heat for temperature control and dumps overboard through an exhaust port near the wing trailing edge (Figure 10-12).

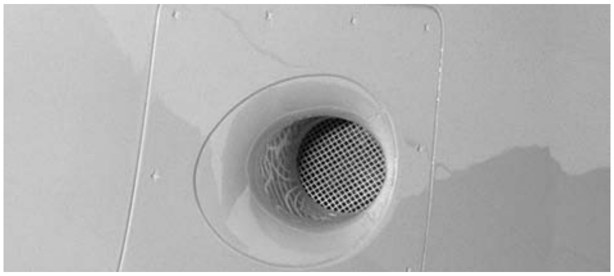

Figure 10-12. Ram-Air Exhaust Port

Wing bleed air temperature is maintained at 300°F (149°C) by a temperature regulating system (Figure 10-13). Ram cooling air flowing aft through the shroud is regulated to extract the proper amount of heat from the hot bleed air flowing forward. The 300° F temperature control sensor at the wing leading edge (entry to heated panel) utilizes 23 psi service air to operate the modulating temperature control valve to control temperature.

The fuel portion of the wing behind the heated wing anti-ice panel is protected from hot bleed air by two factors:

- The head shield installed along the aft closure of the bleed air heated zone.
- Purge passage air flow, lowers the temperature along the forward fuel cell closure. Cool ambient ram-air from the NACA scoop (that feeds the shroud) induces flow through a finger sized hole in the scoop outboard through the wing purge passage to a vent at the lower, outboard edge of the wing anti-ice panel.

Excessive temperature advisory and protection is provided by three 160°F (71°C) overtemp sensors at the following locations:

- Near the midpoint of the wing root at a coupling of the ram-air shroud
- At the leading edge of the wing root fairing
- In the purge-air passage on the forward fuel closure halfway out the wing anti-ice panel

The WING O'HEAT annunciator illuminates for the following reason:

- An overtemperature on any of the three 160°F wing overtemperature sensors.

The wing anti-ice valve (if open) is automatically energized closed on that side providing cool down time, regardless of switch position.

The WING O'HEAT annunciator advises the pilot to reduce power to lower temperature as a backup to automatic valve closure if continuous illumination. After cool down, the annunciator extinguishes and the valve reopens. If pulling the throttle does not cause the annunciator to extinguish, an overtemperature sensor problem may exist. Operating the system on the ground on an extremely hot day with engine power settings above 70% N_1 may result in an overtemperature indication due to insufficient cooling. This does not indicate a system failure under these conditions. The wing anti-ice valve is automatically closed to protect the system.

The ENG ANTI-ICE annunciator illuminates for the following reasons:

- The nacelle inlet is under 220°F (104°C). (See Engine Anti-Ice.)
- The stator valve is not open.
- The temperature near the leading edge of the wing root is under 300°F (149°C).

Illumination of the ENG ANTI-ICE annunciator may indicate an undertemperature condition of the wing anti-ice panel. This advises the pilot to increase power for more heat. When the cold system is initially turned on, on the ground, it is normal for this annunciator to illuminate and take up to two minutes at 70% N_2 to warm up. This annunciator may illuminate inflight below 75% N_2 requiring increased power for more heat.

Normally, each engine supplies bleed air to its respective wing. If an engine is shut down in icing conditions the inoperative wing anti-ice panel can be anti-iced with bleed air from the

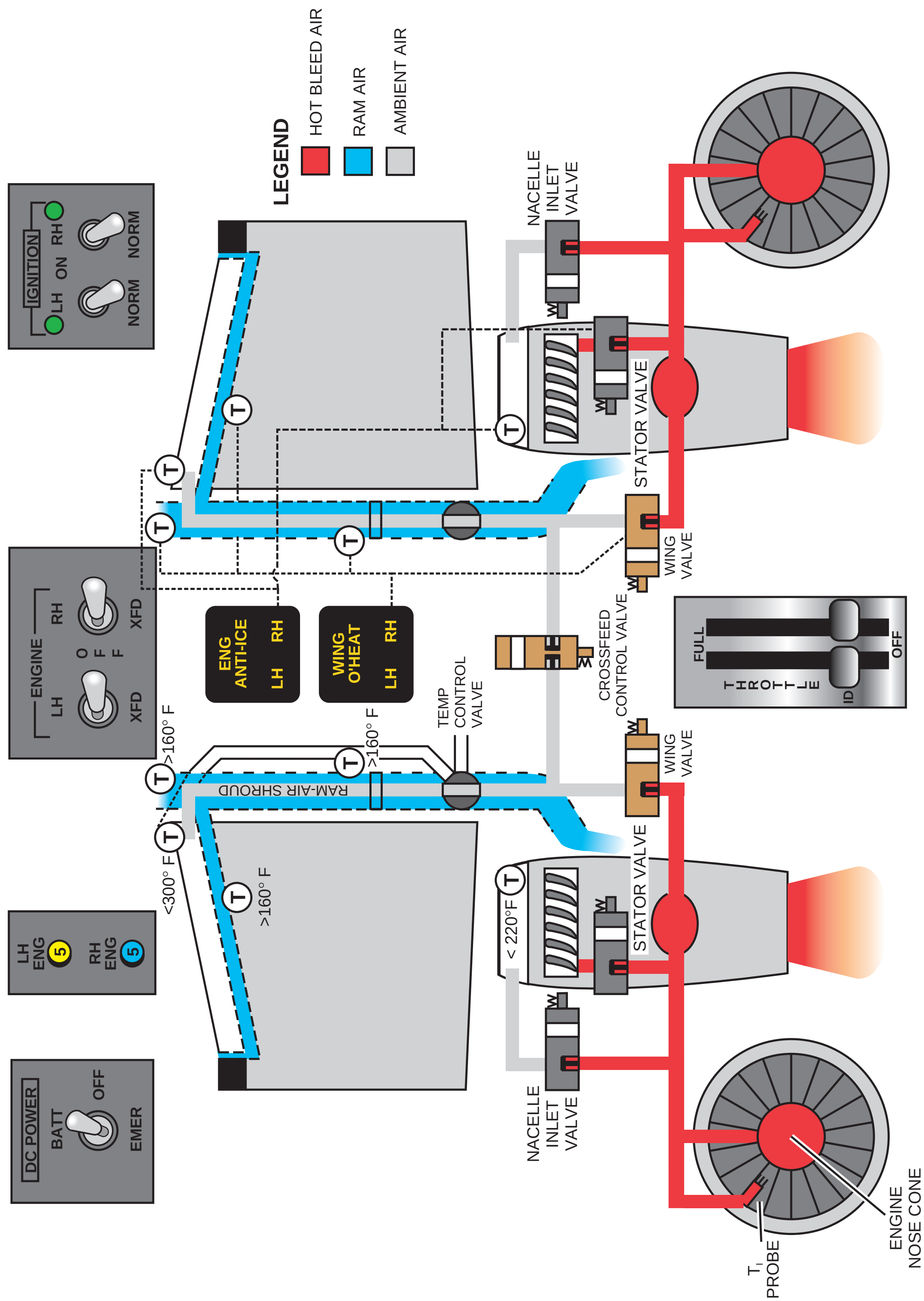

Figure 10-13. Engine and Wing Anti-Ice System

operating engine. Selecting the inoperative ENGINE ANTI-ICE switch to XFD:

- Turns off power to the exciters.
- Deenergizes the nacelle inlet valve and removes the 220°F undertemperature sensor input to the ENG ANTI-ICE annunciator.
- Deenergizes the stator valve and removes its input to the ENG ANTI-ICE annunciator.
- Energizes open the crossfeed valve. This allows bleed air from the operative engine to flow to the wing anti-ice panel of the inoperative engine.
- Energizes the wing anti-ice valve closed preventing air flow to the inoperative engine.

In XFD, the ENG ANTI-ICE annunciator on the inoperative engine illuminates if activated by the 300°F wing anti-ice panel undertemperature sensor. This annunciator advises the crew to increase power on the operating engine for more heat to that wing. The inoperative engine WING O'HEAT annunciator still illuminates due to an overtemperature, but does not affect the crossfeed valve or wing anti-ice valve of the operating engine.

Normally crossfeed is not recommended in two engine operations due to the disabled anti-ice inputs to the ENG ANTI-ICE annunciator on the affected (XFD) engine. If, however, the crew notices ice building on the wing anti-ice panel on one side, selecting XFD on the affected wing panel could prove if that wing anti-ice valve is stuck closed. If the ice goes away the valve is stuck closed. The best choice is to exit the icing environment as soon as practical and turn the system off. Under these circumstances:

- The ignition is turned off. (It can be turned back on using the affected engine ignition switch.)
- The nacelle inlet and stator valves are deenergized open to anti-ice the engine.
- The WING O'HEAT annunciator are fully operational. The ENG ANTI-ICE annunciator illuminates for an undertemperature on the wing panel but the nacelle inlet and stator inputs are removed.
- The wing anti-ice valve is energized closed.

In the event of DC power failure to the nacelle inlet, stator and wing anti-ice valves fail open. All power settings should be computed using anti-ice-on charts. The crossfeed valve fails closed and each engine supplies its respective wing anti-ice panel.

DEICE SYSTEM

Deicing of the outer wing leading edges and the horizontal stabilizer leading edges is provided by inflatable boots controlled by the SURFACE switch on the pilot instrument panel (see Figure 10-14).

Bleed air is available to the system when the engines are operating. A timer controls automatic sequencing of boot operation. Electrical power is from the right crossover bus through the SURFACE DE-ICE circuit breaker on the left circuit-breaker panel.

The system should be activated when ice buildup is estimated to be 1/4 to 1/2 inch thick on the wing leading edge. The stall strip bonded to the boot extends 1/2 inch above the boot and can be used as a guide to estimate ice thickness. Accumulations in excess of 1 inch may not be removed by boot cycling.

If electrical power is lost, the system is inoperative, and icing conditions must be avoided.

Do not activate the system if the OAT temperature is suspected to be below –40˚C. Permanent boot damage could result.

Wing inspection lights are provided to illuminate the wings to observe ice buildup during night flight (Figure 10-15).

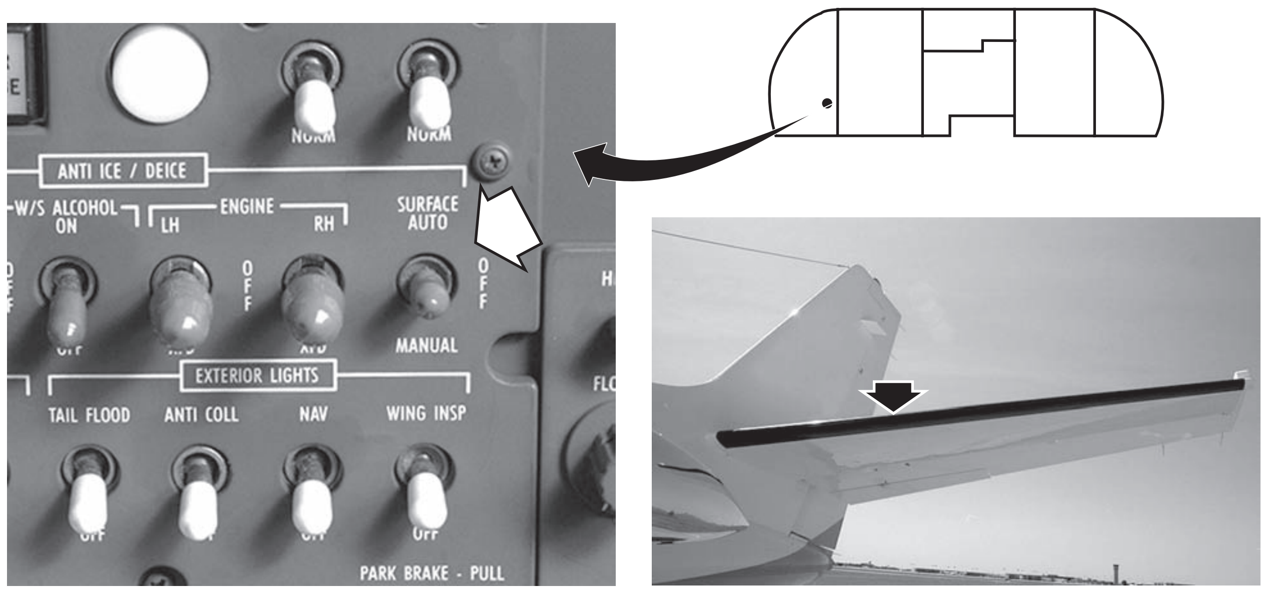

Figure 10-14. Deice Boots and Control Switch

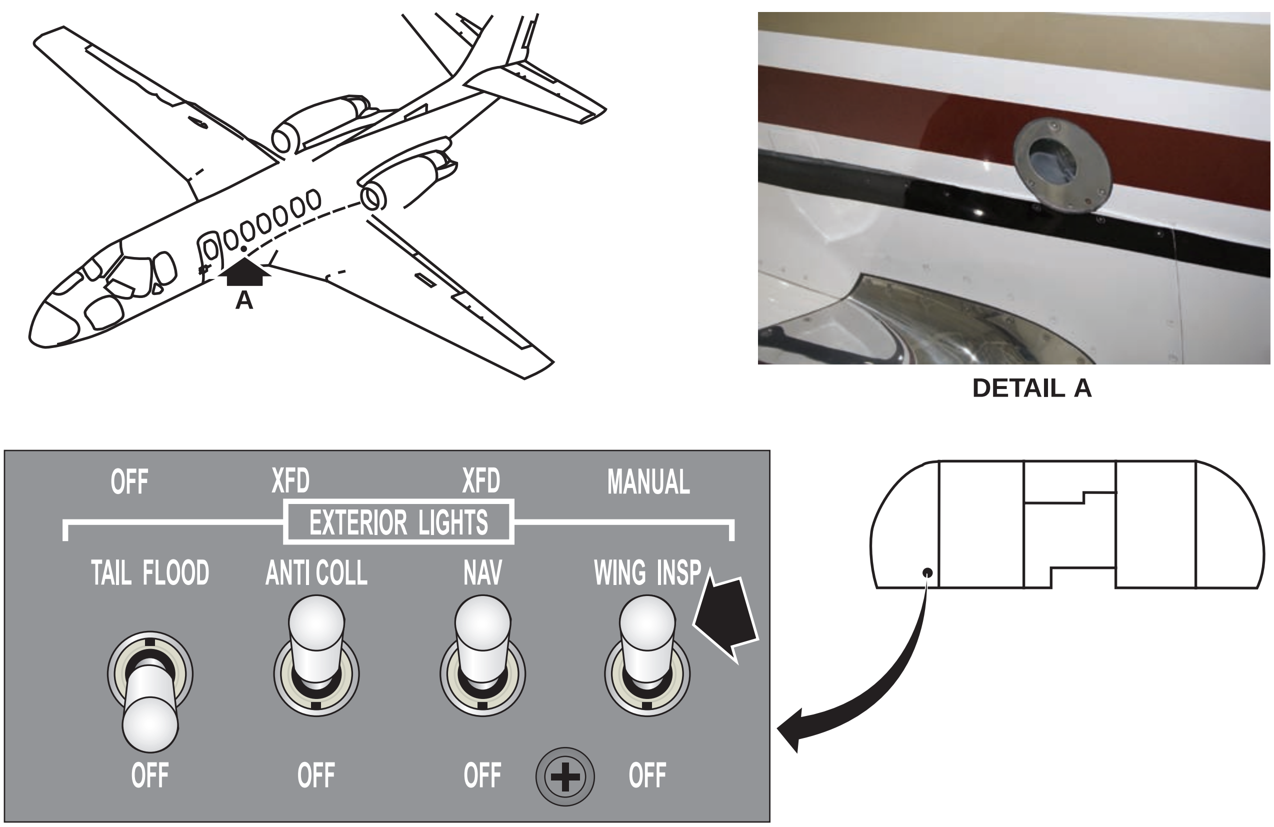

Figure 10-15. Wing Inspection Light and Control Switch

OPERATION

With the SURFACE switch in the spring-loaded OFF position, both boot control valves in the system are deenergized (Figure 10-16).

In the deenergized condition, the control valves are open and continuously dump bleed air overboard through ejectors, which create vacuum to hold the boots deflated.

To cycle the boots, momentarily place the SURFACE switch to the AUTO position. This energizes a system timer to initiate an 18-second cycle. During the first 6 seconds, the control valve to the left horizontal stabilizer and lower wing boots is energized. The control valve closes to direct the bleed air into the boot inflation ducts. After 6 seconds, the control valve is deenergized to create vacuum to return the boots to their deflated position against the wing leading edge. During the middle 6-second time period, both control valves remain deenergized open. Then, the other control valve, which directs bleed air to the right horizontal stabilizer and to the upper wing boots, is energized for 6 seconds to inflate those surfaces. At the completion of the 18-second cycle, both control valves remain deenergized until the control switch is actuated again.

The other spring-loaded position of the SURFACE switch is MANUAL. While the switch is held in this position, both control valves are energized closed, and all boots are inflated. MANUAL can be selected after the automatic timing mode has begun, and all boots inflate; but after the switch is released back to OFF, the automatic mode still completes its cycle. The manual mode serves as a backup way to inflate the boots in the event that the timer for the automatic mode fails.

As each set of boots is inflated, a pressure switch illuminates the white SURFACE DE-ICE annunciator to indicate actuating pressure has been applied (illuminates 2 times during a normal 18-second cycle). For more information on residual ice correction, refer to the *Aircraft Flight Manual*.

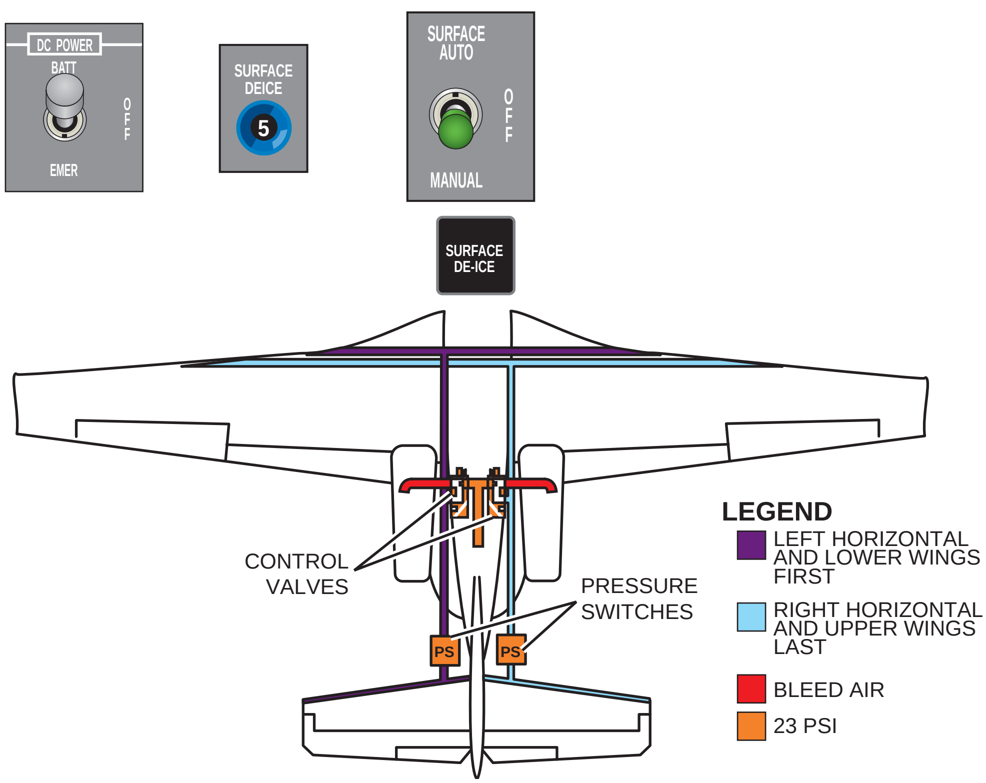

Figure 10-16. Pneumatic Deice System

QUESTIONS

1. The correct statement regarding the pitot-static anti-ice system is:

A. Electrical power is not required (if bleed air is available).

B. The squat switch does not allow full power to the heating elements while the aircraft is on the ground.

C. Failure of one static port heater illuminates the P/S HTR OFF annunciator.

D. Failure of one standby static port heater illuminates the P/S HTR OFF annunciator.

2. Regarding the windshield anti-ice system:

A. The W/S BLEED switch controls volume (HI or LOW).

B. The W/S BLEED switch controls temperature.

C. Electrical power must be available to open the solenoid control valve in the tail cone.

D. Temperature is controlled by the WINDSHIELD BLEED AIR valves.

3. Regarding use of the W/S BLEED switch:

A. HI position should be used with an OAT above –18˚C.

B. LOW position should be used with an OAT below –18˚C.

C. HI position should be used if greater airflow is desired.

D. It deenergizes the solenoid control valve open when HI or LOW is selected.

4. If the W/S AIR O’HEAT annunciator illuminates with the W/S BLEED switch in OFF, there is:

A. 5 psi pressure sensed in the duct.

B. 5 psi pressure buildup in the duct, and the annunciator is to alert the pilot to open the WINDSHIELD BLEED AIR valve to relieve the pressure to prevent damage to the duct.

C. System malfunction; the annunciator should never illuminate with the W/S BLEED switch in OFF.

D. An overtemperature in the duct.

5. The W/S AIR O’HEAT annunciator illuminates:

A. If 5-psi pressure is sensed in the duct with the W/S BLEED switch in OFF and the valves closed.

B. If the temperature of the air going to the windshield exceeds 146°C with the W/S BLEED switch in the HI or LOW position.

C. Neither A nor B.

D. Both A and B.

6. In order to operate the rain removal system, the pilot should:

A. Open the rain doors only.

B. Open the rain doors, and turn on the W/S ALCOHOL switch.

C. Open the rain doors, position the WINDSHIELD BLEED AIR knobs to MAX, and position the W/S BLEED switch to LOW.

D. Open the rain doors, and position the W/S BLEED switch to LOW.

7. The windshield alcohol system:

A. Is a backup system for the windshield anti-ice system.

B. Energizes ejectors which apply alcohol to both the pilot and the copilot windshields.

C. Utilizes a pump that supplies alcohol to the pilot windshield only for a maximum of ten minutes.

D. Both A and C.

8. The surface deice system:

A. Should not be activated until ice thickness exceeds 1/2 inch.

B. Should not be activated until ice thickness exceeds 1/4 inch.

C. functions during an electrical failure because it is pneumatically operated.

D. Has a maximum ice accumulation limit of 2 inches.

9. If the left engine is shut down in flight and XFD is selected with the left ENGINE ANTI-ICE switch (right ENGINE ANTI-ICE switch on):

A. The left ignition light does not illuminate.

B. The ENG ANTI-ICE LH annunciator remains illuminated because the nacelle and stator valves remain closed.

C. If the temperature exceeds 160˚F on the left heated panel, the WING O'HEAT LH annunciator illuminates, and the crossfeed valve is closed.

D. None of the above.

10. Regarding the P/S HTR OFF LH annunciator:

A. It illuminates if the PITOT & STATIC switch is OFF.

B. Illumination of the annunciator could mean the loss of electrical power to the pitot tube.

C. If power is lost to one heated static port on the pilot normal system, the annunciator illuminates.

D. All the above.

11. A correct statement concerning the surface deice system is:

A. The SURFACE switch must be held in the AUTO position for 18 second to ensure that all deice boots receive inflation pressure.

B. The SURFACE switch must be cycled to MANUAL to reset the timer circuit after each use.

C. The system should not be used below –40˚C IOAT.

D. Illumination of the white SURFACE DE-ICE annunciator after the SURFACE switch has been cycled to AUTO indicates a lack of bleed air to the boots.

12. A correct choice regarding engine anti-ice is:

A. When the ENGINE ANTI-ICE switches are positioned to XFD, the two green lights above the ignition switches should illuminate.

B. The throttles must be above 63% N_2 rpm before the wing leading edge anti-ice system is activated.

C. The T_1 temperature probe is anti-iced only when the ENGINE ANTI-ICE switch is selected on.

D. None of the above.

13. Switching on the engine anti-ice system with the engines idling at 52% N_2 causes:

A. An increase in ITT, an increase in amps, and illumination of the ENG ANTI-ICE annunciators for at least five seconds.

B. Illumination of the ENG ANTI-ICE annunciators and remain on until power is increased.

C. No bleed air to flow to the wing leading edges unless rpm is increased above 63% N .

D. The rpm will drop since the nacelle and stator bleed-air valves open at this power setting.

14. The ENG ANTI-ICE annunciator will illuminate when:

A. The wing leading edge temperature is above 160˚F.

B. The nacelle temperature exceeds 220˚F.

C. The bleed-air valve to the stators is not open (all other conditions satisfied).

D. The ENGINE ANTI-ICE switch is in OFF.

CHAPTER 11
AIR CONDITIONING

CONTENTS

Page

ILLUSTRATIONS

CHAPTER 11
AIR CONDITIONING

INTRODUCTION

The air conditioning system for the Citation V Ultra aircraft provides conditioned air to both cockpit and cabin areas. Engine bleed air provides the air required to operate the system. The cabin and cockpit temperature is regulated by mixing hot bleed air with air cooled by an air cycle machine (ACM). Fans are provided to circulate cabin air. A standard vapor cycle air conditioning system is installed to provide additional cooling. An optional flood cooling system is available to provide a means to rapidly cool the cabin temperature.

GENERAL

The crew is provided with automatic and manual temperature controls to operationally condition the cabin and cockpit environment. Hot bleed air is tapped off each engine, manifolded, and routed to the ACM in the tail cone. The air is cooled and distributed through ducting to the cockpit and cabin outlets. Through the use of the pressurization source selector switch, the pilot can select either engine or both engines to supply bleed air for system operation on the ground or in flight. The cabin can be supplied with ambient air in the event the ACM is inoperative and the cabin is unpressurized.

DESCRIPTIONS

AIR CONDITIONING

Bleed air from the engines normally passes through two solenoid-operated flow control valves which restrict the bleed flow to six pounds per minute per engine. The bleed-air line from the right engine branches in the tail cone. One branch is routed to the normal flow control valve and the other to a motor-operated ground valve. This valve can be opened only on the ground and allows a larger mass flow of bleed air from the right engine for use by the ACM.

Control

The six position PRESS SOURCE selector (Figure 11-1) is on the tilt panel forward of the throttle quadrant. This selector along with other air conditioning system devices controls the amount of air that enters the cabin and from what source it is supplied.

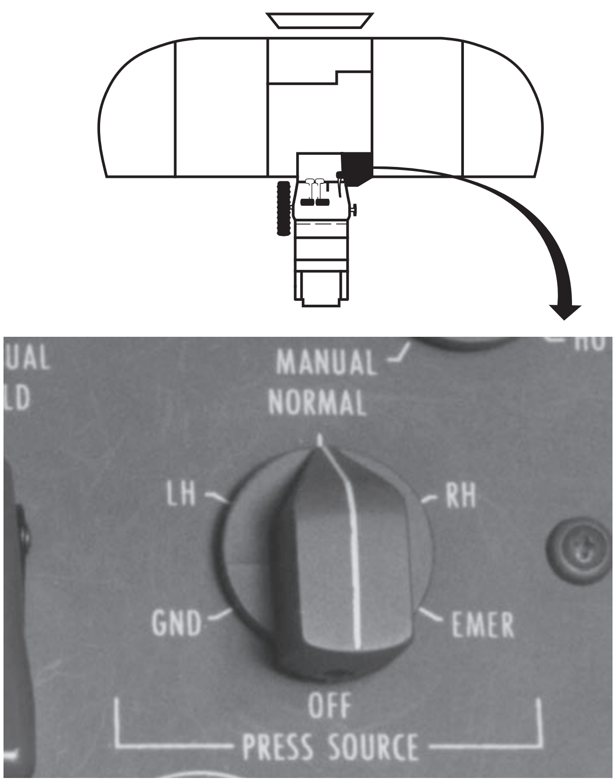

Figure 11-1. PRESS SOURCE Selector

The control switch has an OFF-GND–LH–NORMAL–RH–EMER.

The OFF position of the PRESS SOURCE selector closes all environmental bleed-air valves. The LH and RH flow control and shutoff valves are energized closed by main DC power, the EMER valve is deenergized closed, and the motorized ground valve is deenergized closed at all times inflight by the squat switch. No air flows to the ACM or the pressure vessel. Any differential pressure in the pressure vessel leaks out at the existing fuselage leak rate until internal pressure matches tail cone pressure. The check valves then unseat, and ram air from the tail cone ventilates through the normal distribution ducting. Bleed air is still available to the service air systems.

The NORMAL position deenergizes the LH and RH flow control and shutoff valves open regulating bleed air at 6 pounds-per-minute (ppm)/engine for a total of 12 ppm mass flow from both engines through manifolding to the ACM and the pressure vessel. The flow control and shutoff valves fail open or deenergize to the NORMAL position. If normal DC power is lost; all engine power settings are based on the NORMAL or failsafe open valve positions.

The GND position of the PRESS SOURCE selector is fully functional only on the ground. GND energizes the motorized ground valve open by main DC and allows a larger than normal mass flow of air to flow to the ACM and the pressure vessel. The LH and RH flow control and shutoff valves are energized closed by main DC and the EMER valve is deenergized closed. The BLD AIR GND light is on when the motorized ground valve is not fully on the closed microswitch, i.e., in transit or open. The selection of the GND position inflight should be avoided, but if GND were selected, the motorized ground valve remains deenergized closed by the squat switch. The left and right flow control valves and EMER valve are closed, terminating airflow to the pressure vessel causing decompression of the pressure vessel.

If the right engine is advanced above 72% N_2 (approximately 38 psi), a primary pressure

switch causes the GND valve to motorize closed preventing too much air reaching the ACM turbine. The BLD AIR GND light (Figure 11-2) goes out when the motorized GND valve has closed. When the throttle is retarded below 72% N_2 the GND valve again motorizes open illuminating the BLD AIR GND light. If the primary pressure switch fails to close the GND valve, and the right engine rpm exceeds 74% N_2 (approximately 42 psi), the secondary pressure switch closes the GND valve and illuminates the ACM O'PRESS light. The ACM O'PRESS light indicates the failure of the primary pressure switch. The GND valve is locked in the closed position. Pulling the NORM PRESS circuit breaker interrupts DC power releasing the holding circuit and should restore GND valve operation. The throttle should be pulled to reduce system pressure.

The LH position of the source selector cuts the pneumatic bleed-air input to the ACM and the pressure vessel in half to 6 ppm mass flow. The LH position allows the use of air from the left engine and shuts off air from the right engine. Air flows normally to the service air system. The LH flow control and shutoff valve is deenergized open and the RH flow control and shutoff valve is energized closed by main DC power. The EMER valve is deenergized closed. The GND valve is always closed in flight. The RH source selected position opens the RH bleed valve and closes the LH bleed valve and is otherwise similar.

The emergency pressurization mode (EMER) may be manually selected using the air source selector or automatically selected from any source selector position by the internal ACM overtemperature sensor. The EMER mode energizes the emergency solenoid valve open, the RH and LH flow control and shutoff valves are energized closed, and the motorized ground valve is always closed in flight by the squat switch. EMER requires LH engine operation as a source of bleed air which is piped straight through the aft pressure bulkhead to a venturi in the lower ducting. Heat is dissipated through the expanded surface area of the tubes feeding the system and in the ducts. Cool cabin air is added to lower duct air at the venturi to slow the rise in cabin temperature. The LH throttle is used directly to control source temperature and volume, but generally the cabin temperature rises in this mode.

The amber EMER PRESS ON annunciator light is always ON in the EMER mode whether inflight or on the ground. The emergency valve is always closed on the ground by the squat switch preventing hot bleed air from entering the cabin, and is allowed to open only inflight.

Three reasons exist to select EMER:

- The EMER position is mainly provided as an ***alternate*** means of pressurizing the pressure vessel. A loss of cabin pressurization due to a leaking bleed-air manifold or loose clamp in the tail cone may be restored by selecting EMER. EMER closes the valves to the leaking area by bypassing the ACM. The EMER valve then opens allowing LH engine bleed air to continue to supply a source of air for pressurization. At high altitudes enough heat is extracted so that high altitude pressurized flight (i.e., long oceanic flights) may be continued, though the cabin temperature may rise. At lower, warmer altitudes the heat may be unbearable, and the system may have to be turned off. Temperature can be controlled by varying the LH throttle.

- If an internal overheat occurs inside the ACM it is automatically shut down for a 12-second cool down period to prevent damaging the machine. More on this system later in this chapter.

- If the oil seals on the Hamilton Standard ACM turbine leak, EMER provides a means of turning off oil smoke to the cabin while still remaining pressurized.

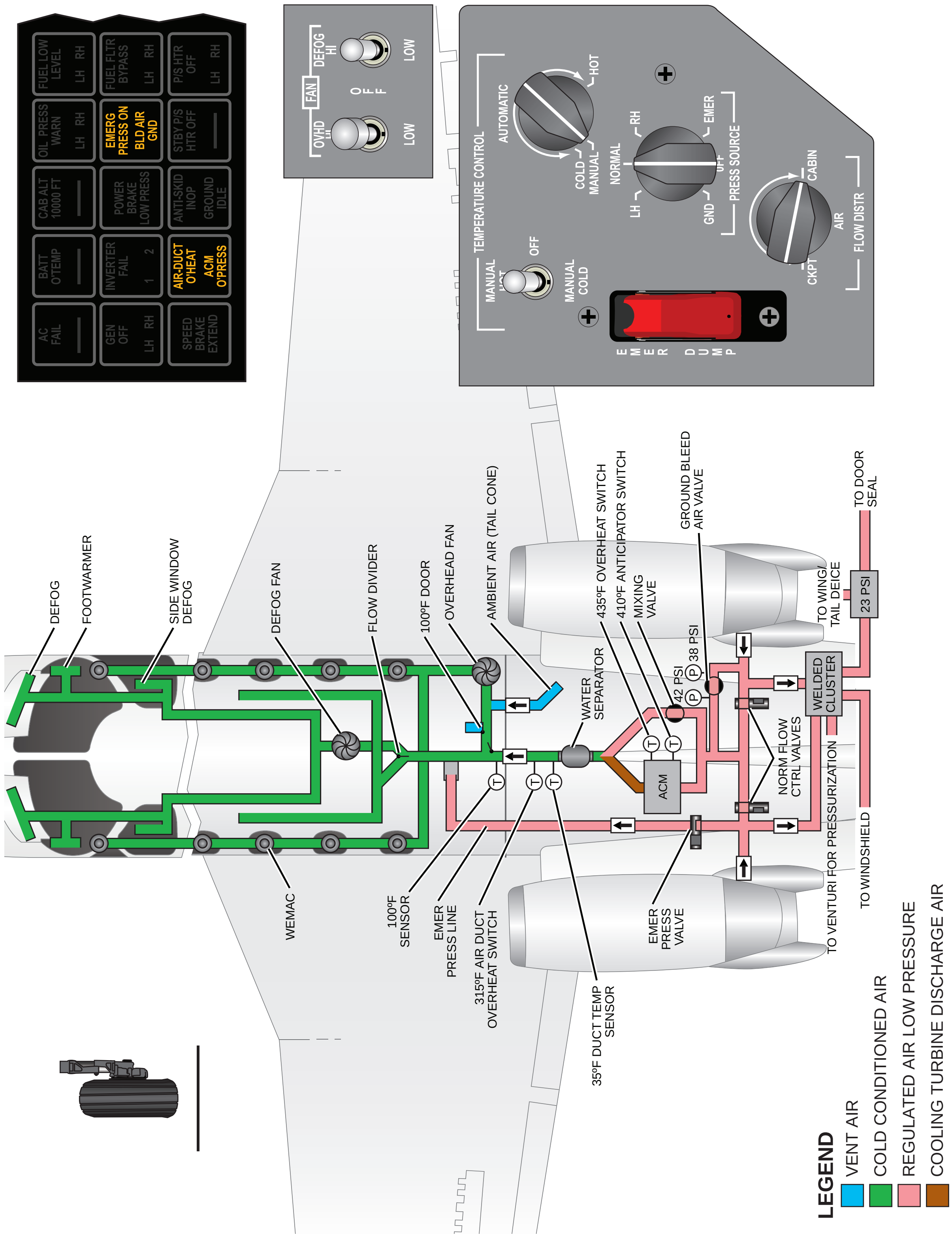

Figure 11-2. Environmental System

Precooler

The bleed air from the engines passes through a precooler that is in the ACM ambient air duct. The air-to-air heat exchanger removes some of the heat energy present in the bleed air before it reaches the ACM heat exchangers. The cooling medium used across the exchanger is ambient air. This air is drawn into the tail compartment and blown through the duct by a fan attached to the ACM turbine shaft.

Air Cycle Machine

After the engine bleed air passes through the precooler in the ram air duct, it enters the ACM primary heat exchanger (Figure 11-3). The air then passes into the ACM compressor, through the secondary heat exchanger, and finally across the cooling turbine where it is expanded. This entire process reduces the temperature of the bleed air supplied by the engines.

Water Separator

A water separator is provided to remove moisture from the conditioned air before it enters the cabin. The conditioned air from the ACM enters the water separator where it is filtered and excess water is removed. The conditioned air is then ducted through a check valve into

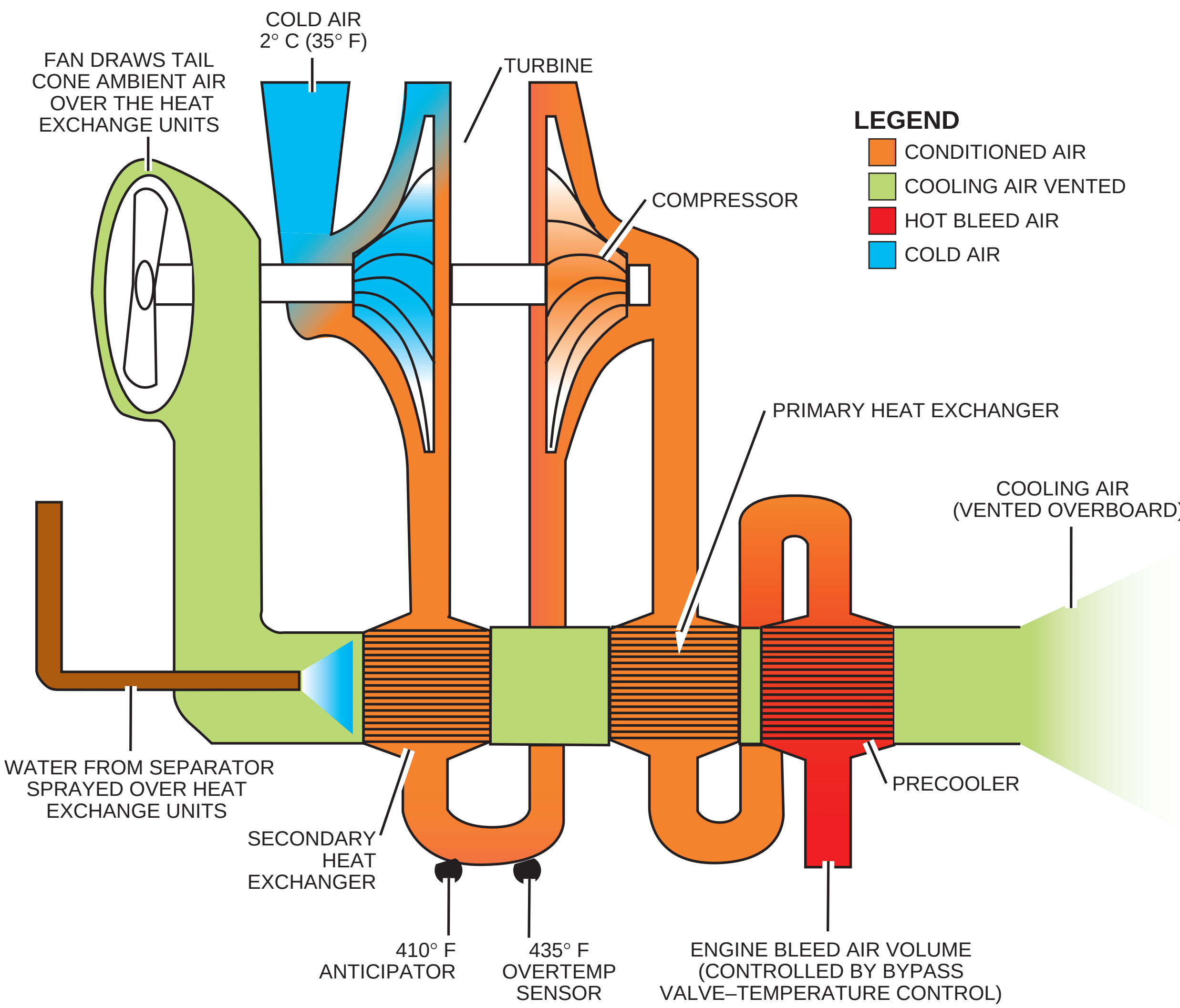

Figure 11-3. Air Cycle Machine

the cabin ducts for distribution. The moisture is injected into the ram air flowing over the heat exchangers to increase cooling efficiency.

Temperature Control

The cabin temperature is controlled by an automatic temperature select rheostat or a MANUAL HOT–MANUAL COLD switch (Figure 11-4). Figure 11-2 illustrates the environmental system, its controls and annunciators.

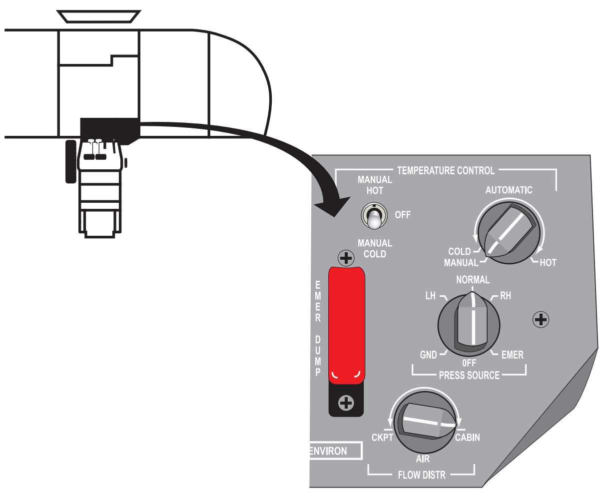

Figure 11-4. Air-Conditioning Controls

The temperature is controlled by allowing some of the engine bleed air to bypass the ACM through a mixing valve. The valve is positioned by an electric motor that requires normal DC electrical power to operate. This valve can be opened (warmer temperature setting) and closed (cooler temperature setting) by either the automatic or manual modes of temperature control.

The cabin temperature is controlled automatically when the temperature rheostat is in the automatic range. This temperature selector is a rheostat which sends a variable temperature setting to a cabin temperature controller. The controller compares the desired setting to the actual cabin temperature provided by a cabin temperature sensor. This sensor is in the bulkhead behind the right rear seat. In addition, the controller receives a temperature input from the supply duct temperature sensor in the tail cone. The cabin controller compares all of the electrical inputs and then sends an output signal to the mixing valve motor in order to change the supply temperature. For example, if the selector is rotated clockwise by the pilot, he/she is selecting a higher temperature. The controller receives this input and compares it to the signals received from the cabin and supply duct sensors and then causes the mixing valve to open up, allowing more bleed air to bypass the ACM, thus increasing the temperature in the cabin.

In the automatic mode, the system has a supply air low temperature limit of 35°F to prevent the formation of ice in the water separator. The input to the controller for this is from the supply duct temperature sensor downstream of the water separator in the supply duct.

With the automatic temperature rheostat in the MANUAL position, the mixing valve is controlled manually by the MANUAL HOT–MANUAL COLD switch. The switch has three positions and is spring-loaded to the center position. When the switch is deflected toward MANUAL HOT, the mixing valve is electrically driven open, allowing more hot bleed air to mix with the cold air exhausted from the ACM. When the switch is released, the mixing valve remains at the last position. Toggling the switch toward MANUAL COLD electrically drives the mixing valve to the closed position, thus lowering the temperature. The mixing valve, when manually controlled, travels from full open to full closed in approximately ten seconds. Caution should be observed when operating in the manual mode to prevent water separator freeze-up.

System Protection

If the bleed-air temperature in the duct between the compressor and turbine sections exceeds 435°F, the overheat sensor causes the flow control and shutoff valves or the ground valve (depending on which is open) to close

and the emergency pressurization valve to open. The ACM shuts down and the cabin is pressurized by bleed air from the left engine. This condition is indicated by the EMER PRESS ON annunciator light and an increased noise level in the cabin. If the overheat condition in the ACM exists for longer than 12 seconds, the emergency lockout relay is energized, and the ACM remains inoperative. If the ACM cools down within 12 seconds, it reverts to its previous setting, and the emergency pressurization valve closes.

To reset the system for normal operation after a shutdown for longer than 12 seconds, it is necessary to rotate the PRESS SOURCE selector to the EMER position and then reselect a position other than GND or OFF. This condition is most likely to occur when maximum cooling is demanded of the system.

On the ground, when the ACM overheats, the emergency pressurization valve does not open since it has been deactivated by the squat switch on the left main gear. However, the EMER PRESS ON annunciator light ***does*** illuminate. The reset procedures are the same as for in flight. When the emergency pressurization valve is providing the source of air for pressurizing the cabin, the pilot is unable to control the temperature except through manipulation of the left throttle. Reducing power on the left engine reduces the temperature and volume of air entering the cabin. Reducing it too much causes a rise in cabin altitude. The source of air for the emergency pressurization system is from the left engine only (see Figure 11-2).

To prevent nuisance trips of the ACM at high altitude (where there are fewer molecules of cooling air), there is an anticipator sensor installed in the ACM duct just downstream of the overheat sensor (see Figure 11-3). When the temperature reaches approximately 410°F (210°C), this sensor biases the input from the cabin temperature sensor down 30°. The result is that the controller opens the mixing valve to ask for more heat, thus relieving the load on the ACM by bypassing some of the hot bleed air around it. The temperature control should be placed in AUTO when the aircraft departs lightly loaded and climbs rapidly to altitude on a hot day for anticipator protection. ***All*** operations above 31,000 feet should be in AUTO.

The air duct from the ACM to the cabin is protected from overheat damage by a duct overheat sensor. If the temperature in the duct exceeds 157°C (315°F), the AIR DUCT O'HEAT annunciator light illuminates (see Figure 11-2). This condition most likely occurs when heat is being demanded and most of the bleed air is bypassing the cooling process of the ACM. The pilot should select MANUAL with the automatic temperature select rheostat and close the mixing valve by holding the MANUAL HOT/MANUAL COLD switch to MANUAL COLD. Approximately ten seconds is required to drive the mixing valve from the full hot to the full cold position. The pilot should also check that the TEMP circuit breaker on the LH CB panel is in. The electrical power to the mixing valve is from the left extension bus through the TEMP circuit breaker. Loss of power to that bus or opening of the circuit breaker renders the temperature control system inoperative in both automatic and manual modes.

If complete DC electrical power failure occurs, regardless of the PRESS SOURCE selector position, the system operates as though the switch is in the NORMAL position. If the selector is in the NORMAL position when the electrical failure occurs, the air conditioning system continues to operate in that mode. Without electrical power, the emergency pressurization valve fails closed. In addition, temperature control is lost because the motor-operated mixing valve fails to the position set when electrical power is lost. If selected, the GND valve fails where it was when power was lost.

Air Distribution

Description

The cabin air distribution system consists of an overhead conditioned air duct and outlets. The passenger footwarmer and armrest warmer manifolds are supplied by an under-floor conditioned air duct which supplies the

windshield defog outlets, and the crew side console outlets. Figure 11-5 illustrates the air distribution system. The conditioned air enters the cabin through a single duct and then branches at a flow divider, part going to the cockpit and part going to the main and auxiliary plenum, then on to the passenger section. Air circulation through both the overhead ducting and underfloor ducting can be increased by actuating the overhead fan and defog fan, respectively.

Operation

With the engines operating, selecting a source of bleed air for the ACM with the pressurization source selector provides conditioned air to the cabin (EMER and OFF positions excepted). The air flows from the water separator through ducting to the cabin, passing through a check valve at the aft pressure bulkhead.

The temperature of the air in the supply duct determines the position of the recirculating air inlet door. At temperatures below 38°C, the door is fully closed, and conditioned air flows through both the overhead and under-floor distribution ducts. With a temperature above 38°C, the door is fully open, and all of the hot air from the ACM is diverted to the underfloor ducting system. Air from the overhead ducts is now recirculated cabin air only, which is cooler than the air coming from the ACM. The air flowing through the overhead ducting is distributed and controlled by manipulation of the individual Wemac outlets. Increased airflow through these Wemac outlets can be obtained by selecting HI or LOW with the OVHD fan switch on the copilot instrument panel (Figure 11-6).

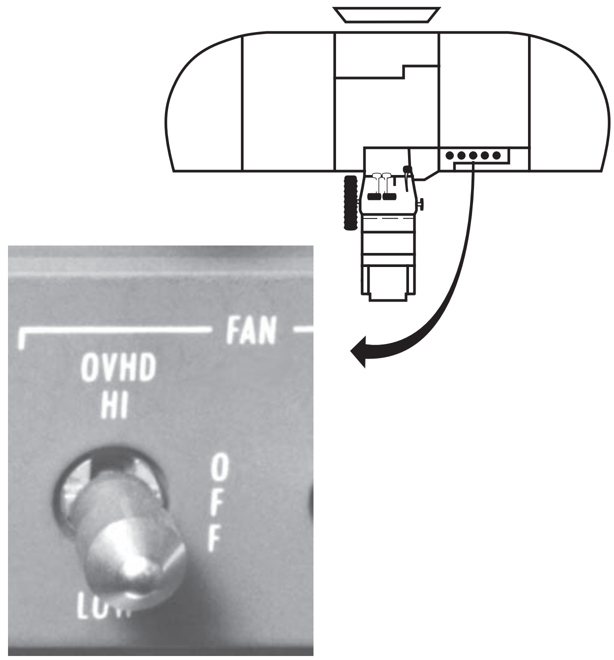

Figure 11-6. OVHD Fan Switch

The air that flows to the underfloor ducting is divided by the flow divider assembly. Part of the air flows to the flight compartment and part to the passenger footwarmer and armrest warmer manifolds. The position of the flow bias valve is determined by the AIR FLOW DISTR selector. It is a five-position selector that allows selection of increased or decreased airflow to the cabin or cockpit (Figures 11-4 and 11-5). For example, selecting the CKPT position diverts most of the air to the flight compartment, while selecting CABIN diverts most of the air to the armrest and footwarmer manifolds. Using the defog fan in conjunction with the flow divider increases the airflow to the flight compartment. Maximum flow can be obtained by selecting CKPT with the AIR FLOW DISTR selector and selecting HI with the defog fan switch. The defog fan switch is adjacent to the overhead fan switch on the copilot instrument panel and has three positions: HI, OFF, and LOW. The pilot footwarmer outlet must be closed to obtain maximum defogging at the windshields. When the footwarmer outlet is closed, a side window defog valve is also closed, preventing moist air from finding its way into the area between the side window panes and condensing as it meets the cold-soaked outer pane of glass.

VAPOR CYCLE AIR CONDITIONER

A vapor cycle air conditioner discharges conditioned air from floor-mounted evaporator/fans in the forward and aft ends of the dropped isle to provide rapid cabin cooling.

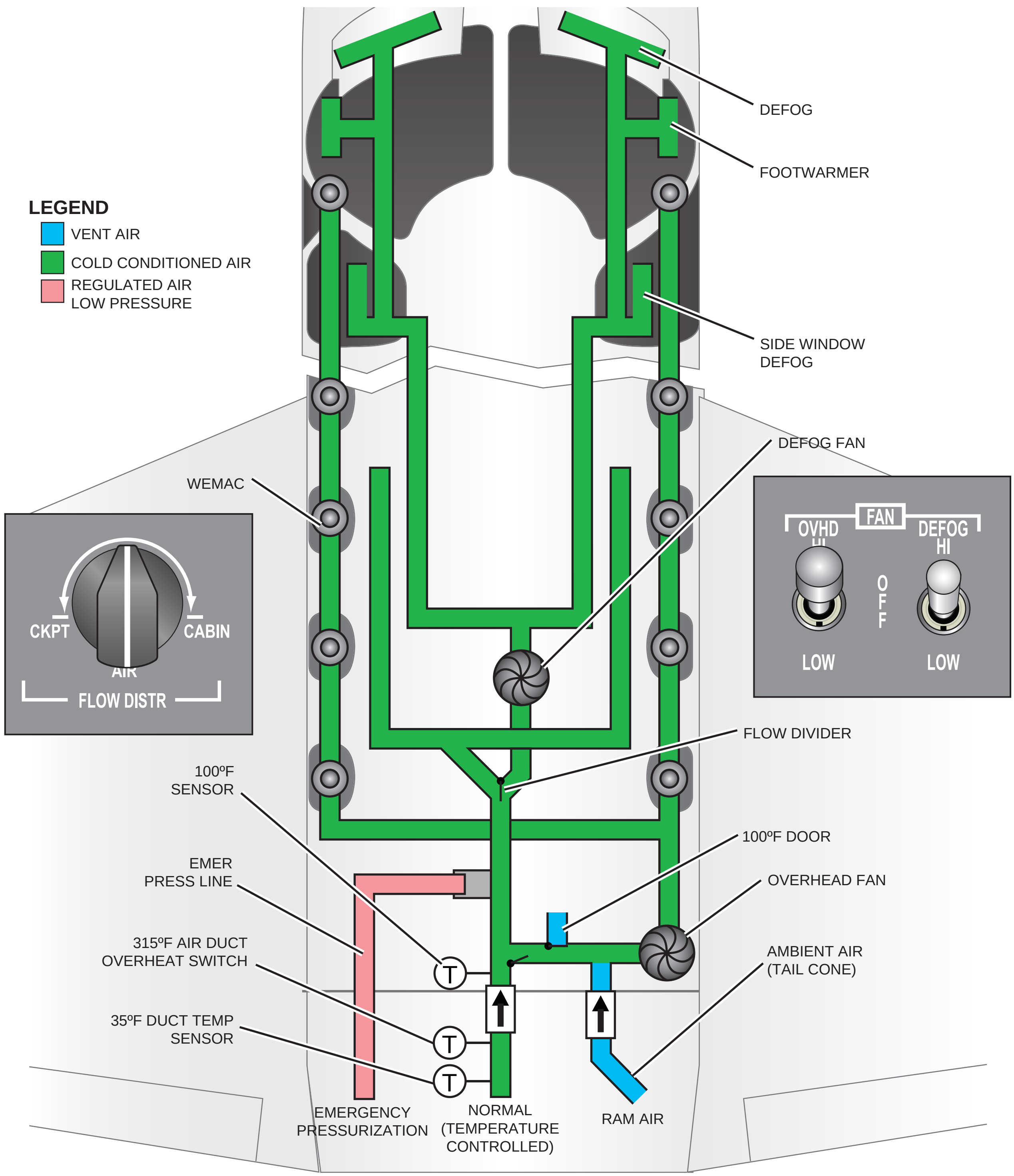

Figure 11-5. Air Distribution System

The air conditioner is controlled by a switch panel on the copilot instrument panel and can be used on the ground or in flight up to 18,000 feet (Figure 11-7).

Figure 11-7. A/C Control Panel

The MODE A/C–FAN–OFF switch controls primary power to the system. The A/C position turns on the compressor and the forward blower. The FWD FAN HI–LO switch controls the forward blower speed when the MODE switch is in A/C or FAN. A COMP ON twist-dimmable light illuminates when the compressor is powered.

The system may not be operated in the A/C mode above 18,000 feet. UNs 293, 295, 298, 299, 301 and subsequent utilize R-134 refrigerant and earlier units use R-12 freon refrigerant. The compressor must be manually turned OFF above 18,000 feet by selecting OFF or FAN. An EPU or any generator must be on line to run the compressor on the ground. In flight, it automatically loads shed if any generator fails via the left squat switch. Moisture from the two evaporators is drained overboard through heated drains.

OPTIONAL FLOOD COOLING

The flood cooling system provides an air outlet grill on the upper aft pressure bulkhead to supply a high volume of cool air directly from the ACM (Figure 11-8). It bypasses the normal overhead and underfoot duct system and eliminates the heating of the conditioned air by the hot-soaked distribution ducting. It is intended for cooling purposes only, and in flight may be used only below 10,000 feet.

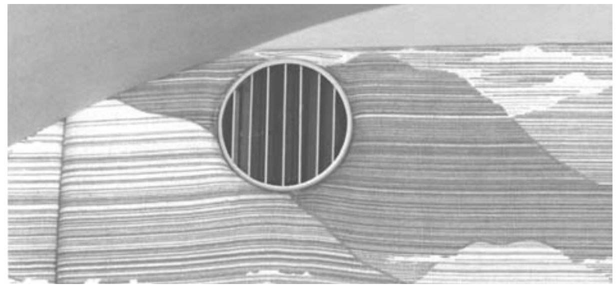

Figure 11-8. Flood Cooling Outlet

Operation

The flood cooling control switch (Figure 11-9) is next to the pressurization controller on the center panel in the cockpit. It is a two-position switch with an ON and OFF position. It requires power from the RH generator or EPU for ground operation.

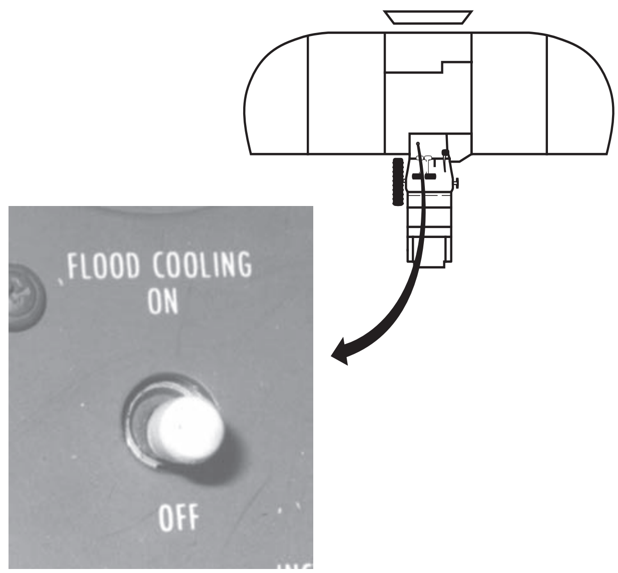

Figure 11-9. FLOOD COOLING Switch

When the FLOOD COOLING switch is in OFF, the conditioned air is directed through the normal distribution system. When the switch is placed to the ON position, the conditioned air is blocked off from the normal distribution system, and all conditioned air is directed into the flood cooling duct.

Installed in the flood duct is a DC-powered axial blower which increases the flow of air. At low power settings, with the flood cooling selected ON, the ACM does not supply enough conditioned air to the blower, so it draws in ambient air from the tail cone and mixes it with the conditioned air.

As the engine power is increased, thus increasing the supply of conditioned air, the ambient air check valve closes, and all of the air entering the cabin is then conditioned air.

LIMITATIONS

FLOOD COOLING SYSTEM

Operation of the flood cooling system is prohibited above 10,000 feet pressure altitude and is not to be used for cabin heating.

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QUESTIONS

1. When controlling the cabin temperature with the manual temperature switch, the mixing valve is positioned from full hot to full cold in approximately:

A. 18 seconds
B. 6 seconds
C. 3 seconds
D. 10 seconds

2. The AIR DUCT O'HEAT annunciator light illuminates when the:

A. ACM shuts down.
B. Temperature of air in the duct to the cabin is excessive.
C. Temperature of the air going to the windshield is excessive.
D. EMER source is selected unless the left throttle is retarded.

3. If the ACM overheat switch has activated, it may be reset by placing the PRESS SOURCE selector in:

A. EMER and NORM
B. GND
C. NORMAL
D. Either LH or RH

4. Selecting the HI position with the OVHD fan switch:

A. Increases the airflow through the overhead ducts.
B. Increases airflow through the underfloor ducts.
C. Increases the airflow in the windshield defog system.
D. Keeps the toilet area ventilated.

5. Closing the footwarmers on descent:

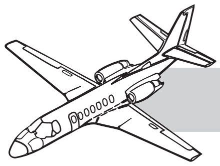
A. Cuts off all airflow to the windshields.
B. Cuts off all air to the side windows.
C. Increases airflow to the side windows for defogging on descent.
D. Results in side window fogging.

6. The source of bleed air when the EMER PRESS ON annunciator is illuminated in flight is:

A. Either the left or right engine.
B. The left engine only.
C. The right engine only (provided that the GND position is not selected).
D. Ram air.

7. The OAT is 90°F; as the aircraft passes through 4,000 feet on climbout, the EMER PRESS ON light illuminates and the noise level in the cockpit increases:

A. The ACM has shut down due to an overheat; select EMER with the PRESS SOURCE selector and a cooler temperature with the automatic temperature selector.
B. The ACM has shut down; turn the PRESS SOURCE selector OFF and call for the checklist.
C. The ACM has shut down due to an overheat; select a warmer setting, wait for 12 seconds, and call for the checklist.
D. The ACM has not shut down; select MANUAL and full cold to cool it down, thus preventing damage.

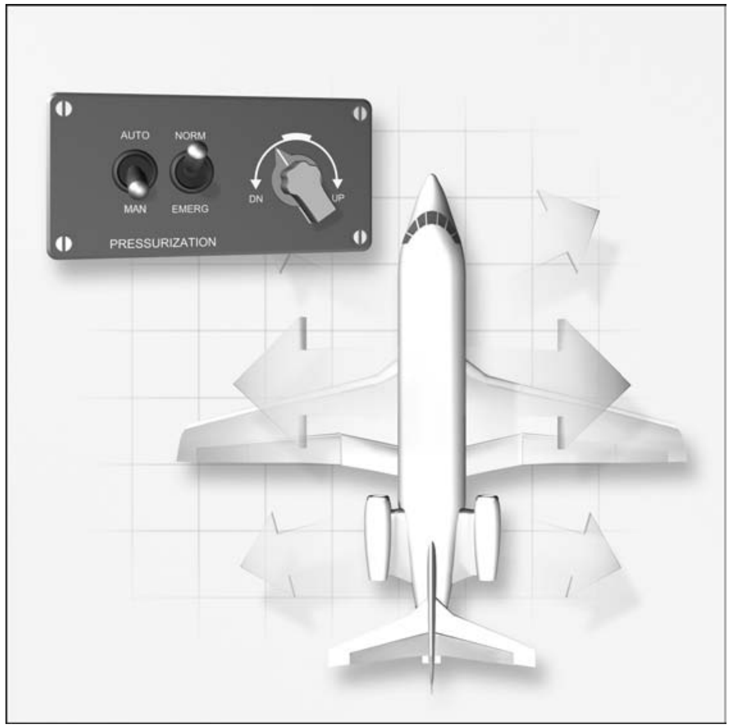


CHAPTER 12
PRESSURIZATION

CONTENTS

ILLUSTRATIONS

CHAPTER 12
PRESSURIZATION



INTRODUCTION

The pressurization system on the Citation V Ultra aircraft is used to maintain a lower cabin (pressure vessel) altitude than actual aircraft altitude. This is accomplished by controlling the amount of air allowed to escape overboard from the cabin. On the Citation V ULTRA, the pressurization and air-conditioning systems employ a common airflow; therefore, cabin pressurization is accomplished with conditioned air.

GENERAL

Two elements are required to provide cabin pressurization. One is a constant source of air. The other is a method of controlling the flow of air into or out of the aircraft to achieve the desired differential pressure and resultant cabin altitude. In the Citation V ULTRA, the inflow of air to the cabin is fairly constant (through a wide range of engine power settings), and the outflow of air is controlled by the two outflow valves on the aft pressure bulkhead. The cabin pressure control system includes a pressure controller, two outflow valves, two cabin altitude limit valves, and a pneumatic relay. An emergency dump valve and a regulated vacuum supply complete the cabin pressure control system.

Cabin pressurization is obtained by releasing conditioned air under pressure into the fuselage and limiting the rate at which the air is exhausted to the atmosphere. The purpose of the pressurization control system is to keep the cabin of the aircraft as near sea level pressure as possible throughout the varying altitudes during flight. The pressurized area of the aircraft can be maintained at sea level pressure up to a flight altitude of approximately 23,000 feet and at a pressure altitude of approximately 8,000 feet while the aircraft is at 45,000 feet. These pressures impose a normal cabin-to-atmosphere pressure differential up to 8.9 psi on the aircraft structure.

The tail cone utilizes ram air to provide positive pressure to the tail cone (relative to outside static pressure) to preclude entry of any external fluids.

DESCRIPTION

PRESSURIZATION CONTROLLER

The pressurization control system uses a variable isobaric controller to drive two identical outflow valves through a compensated pneumatic relay (Figure 12-1). Both outflow valves modulate the flow of air discharging from the cabin during normal operation. Either or both valves open automatically if required to provide positive pressure relief protection. Each valve is connected to a cabin altitude limit control unit, which automatically overrides any pressurization control system failure that would cause cabin altitude to exceed 13,000 ± 1,500 feet.

The system incorporates three solenoid valves that are functional primarily during ground operations (Figure 12-1). Solenoid A, on the controller, is a normally open valve that is energized closed when either or both throttles are above 85% N_2 and the aircraft is on the ground. This valve remains closed during the takeoff roll to disable the rate-control function of the controller and allow the pneumatic relay to control pressurization.

Solenoids B and C are two-way, two-position, normally closed valves. The valves are energized open when either throttle is below 80% N_2 and the aircraft is on the ground.

The three solenoid air valves are connected to the aircraft electrical system through the NORM PRESS circuit breaker on the left circuit-breaker panel. Ground for the valves' circuitry is completed through two parallel throttle switches on the aft quadrant and the left gear squat switch. These three solenoid valves are further discussed under Operation.

It is the function of the controller to meter control air (vacuum) to the outflow valves so that desired cabin altitude and rate of climb are achieved. The controller consists of two chambers separated by a movable diaphragm. One chamber senses cabin pressure while the other chamber references ambient pressure outside the pressure vessel. Pressure differences between the two chambers, resulting from changes in altitude, cause the diaphragm to move and route control air to the pneumatic relay. The pneumatic relay amplifies this signal and, in turn, controls the two outflow valves. Cabin pressure is then increased or decreased until equilibrium between the two chambers is established. Desired cabin altitude is selected by rotating the cabin altitude selector knob. This applies a spring bias to the movable diaphragm and changes the pressure between the two chambers causing cabin pressure altitude to climb or dive.

The rate at which the cabin climbs or descends is controlled by the cabin rate knob. This valve bleeds air between the two sealed chambers and, in conjunction with an isobaric bellows, determines the rate at which the spring pressure is applied to the movable diaphragm when a new cabin altitude is selected.

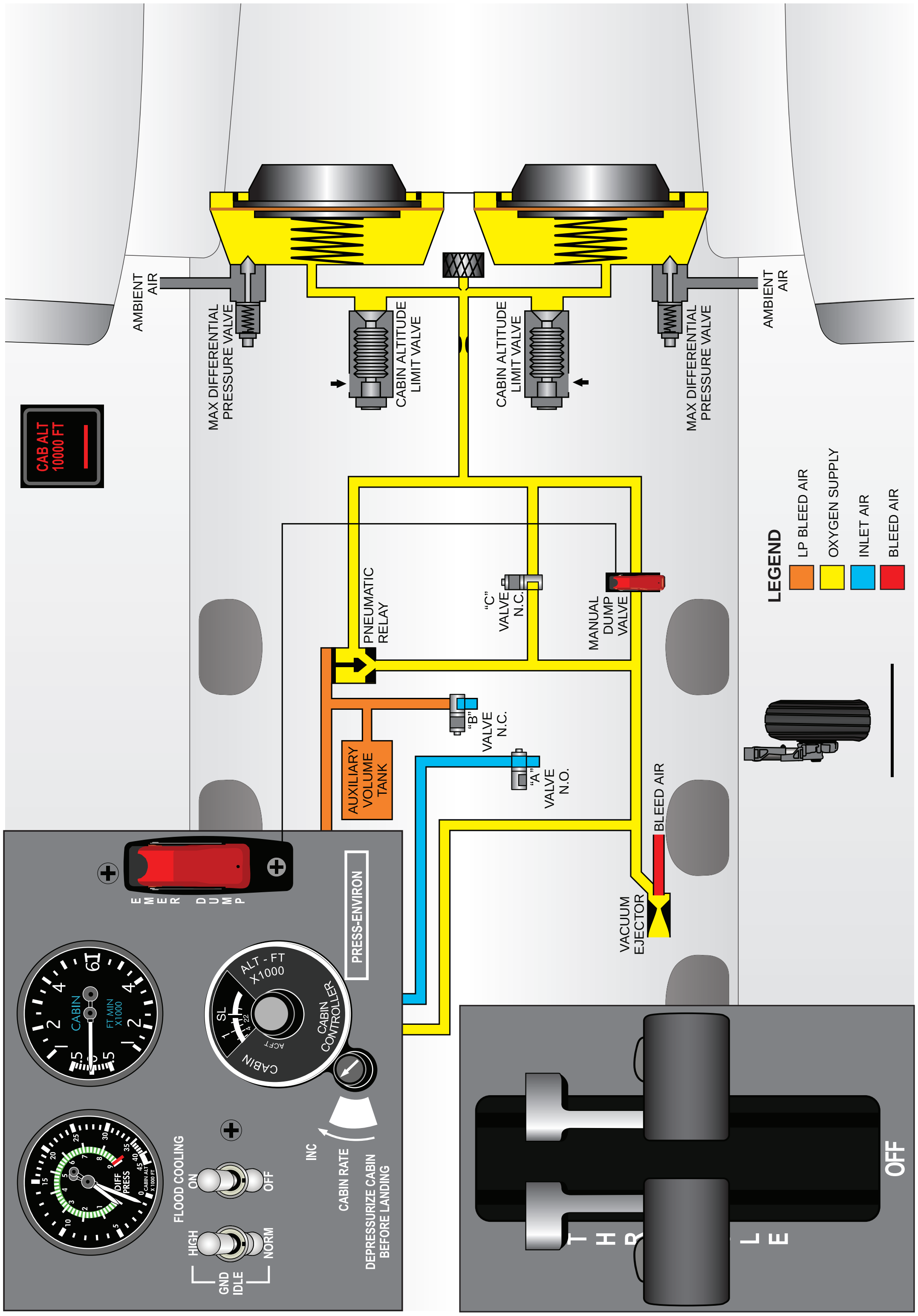


Figure 12-1. Pressurization System

The cabin altimeter and cabin rate-of-change indicators are on the center pedestal, adjacent to the pressurization controller (Figure 12-2). The cabin altimeter presents existing cabin altitude on the outer scale and pressure differential on the inner scale. The pressure differential needle indicates multiple malfunctions of the outflow system if a pressure differential in excess of 8.9 psi is shown on the gauge. The cabin rate-of-change indicator shows the rate at which the cabin is ascending or descending.

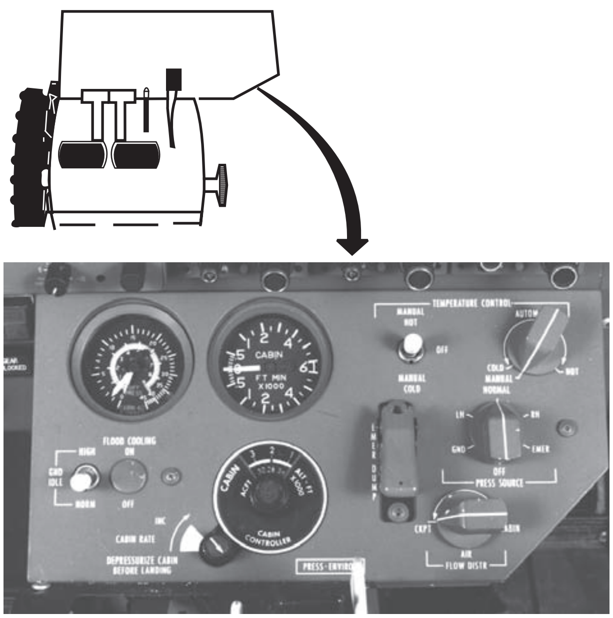


Figure 12-2. Pressurization Controls and Indicators

OUTFLOW VALVES

There are two forces at work on the outflow valves at all times. The first is a spring which is always attempting to close the respective valve, restricting the outflow of air and causing the cabin to descend, or pressurize. Offsetting this spring is the control air (vacuum) regulated by the cabin pressure controller and amplified by the pneumatic relay. This tends to pull the outflow valve off the seat allowing air to escape, climbing, or depressurizing, the cabin. In the event that control vacuum should exceed limits due to a malfunction, cabin altitude limit valves are provided to prevent cabin altitude from exceeding 13,000 ± 1,500 feet. If the control vacuum exceeds the barometric reference in the cabin altitude limit valves, they open and allow cabin air to enter the control air line, reducing the vacuum. This causes the outflow valves to move toward the closed position and re-establish cabin pressure. A manual emergency dump valve in the vacuum line can be utilized to route vacuum to the outflow valves and can dump the cabin pressure to an altitude of 13,000 ± 1,500 feet.The dump valve lever is covered by a guard to prevent accidental operation (Figure 12-3).

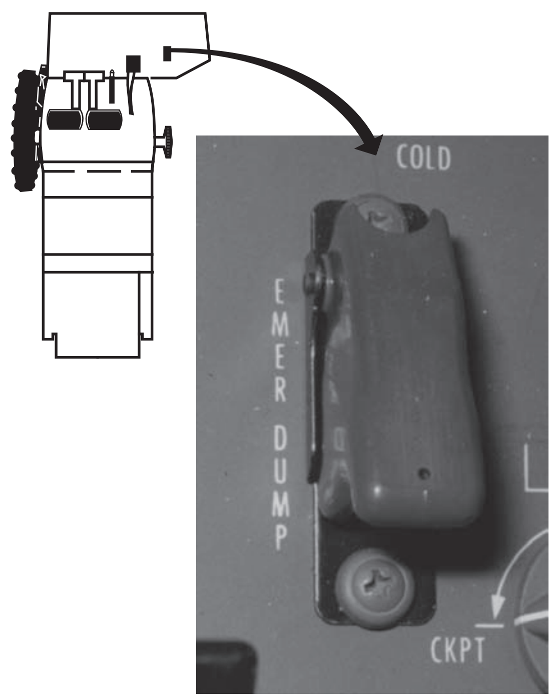


Figure 12-3. Manual Emergency Dump Valve Lever

The outflow valves are calibrated to regulate cabin differential pressure at 8.8 ± 0.1 psi. During taxi mode operation, vacuum through solenoid C is routed directly to fully open both outflow valves, assuring that the aircraft is depressurized during all ground operations. This is accomplished by solenoid C valve energized by the squat switch with the throttles below 85% N_2.

OPERATION

Prior to takeoff, the desired cruise altitude is set to ACFT on the pressurization controller dial. Cabin altitude at this cruise altitude is then displayed as CABIN on the adjacent scale. Position the rate control selector so that the pointer falls within the nominal white arc.

During the takeoff roll, advancement of the throttles, beyond 85% N_2, operates three solenoid valves (closed), moving the outflow valves into the controlling range and trapping ambient pressure for reference by the pneumatic relay. After liftoff, all solenoids are deenergized and normal control of cabin pressurization and rate is returned to the controller (A–open, B–closed, C–closed).

When preparing to land, the crew should select at least 200 feet above the landing field pressure altitude on the controller, and a rate compatible with the intended rate of descent. When the cabin reaches the selected altitude, the system maintains the cabin at 200 feet above field pressure altitude until the aircraft descends below this level. The valves are controlled open as the aircraft passes through the 200-foot level, assuring an unpressurized cabin during landing.

At touchdown, with the throttles at less than the 80% N_2 position, the left landing gear squat switch causes solenoid B and C valves to open. With the aircraft previously unpressurized, the full open signal provided by the solenoid valves has little effect. This feature ensures that the cabin is unpressurized for ground operations.

Since the only electrical circuit involved in the pressurization system is the takeoff and landing function of the squat switch, loss of electrical power does not affect the ability to pressurize or depressurize the aircraft in flight.

However, if the aircraft vacuum system fails, the pressure controller becomes inoperative, the outflow valves close, and the cabin pressure is maintained at 8.9 psid (full differential) by the differential pressure limiters installed in each outflow valve. Partial depressurization may be accomplished by selecting LH or RH on the source selector and pulling the appropriate throttle. This cuts source air from 12 ppm to 6 ppm flow rate. Full depressurization is completed by selecting OFF on the source selector stopping all air flow into the pressure vessel. This allows existing differential pressure to slowly leak out to achieve zero differential pressure before touchdown.

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QUESTIONS

1. Pressurization of the aircraft is normally maintained by:

A. Controlling the amount of air entering the cabin.
B. Controlling the amount of air escaping the cabin.
C. Modulating the temperature of the ACM.
D. Manipulating the throttles.

2. If the main vacuum source to the pressurization controller is lost, the aircraft pressure differential will:

A. Go to zero as the aircraft depressurizes.
B. Go to maximum limits as allowed by the outflow valves.
C. Stabilize at about 13,500 feet as controlled by the altitude limit valve.
D. Cause the passenger oxygen system to activate.

3. The emergency dump valve:

A. Fail safe opens if electrical power is lost.
B. Is effective whether vacuum is available or not.
C. Is intended for ground use only in the event of a vacuum failure.
D. Depends upon vacuum to have any effect on pressurization.

4. The landing gear squat switch causes the aircraft to completely depressurize while on the ground by opening a solenoid valve, routing vacuum directly to:

A. Both outflow valves.
B. The pressure controller.
C. The cabin altitude limit valve.
D. The emergency dump valve.

5. While cruising at FL350 the aircraft vacuum system fails. The cabin altitude:

A. Immediately goes to 13,500 feet.
B. Remains at approximately 10,000 feet (as set by the limiters).
C. Rapidly approaches 35,000 feet.
D. Decreases to a value as determined by the maximum differential pressure.

6. The source of bleed air for cabin pressurization when the EMERG PRESS ON light is illuminated in flight is:

A. Either the left or right engine.
B. The left engine only.
C. The right engine only.
D. Ram air.

CHAPTER 13
HYDRAULIC POWER SYSTEM

CONTENTS

ILLUSTRATIONS

CHAPTER 13
HYDRAULIC POWER SYSTEM

INTRODUCTION

The Citation V Ultra aircraft hydraulic system is pressurized by two engine-driven pumps, one on each engine. The system provides pressure for four subsystems: landing gear, speedbrakes, flaps, and thrust reversers. System operation is monitored by annunciators.

GENERAL

The hydraulic system is an “open center” design. Pump output is bypassed to return with little buildup of pressure until operation of a subsystem is initiated.

The pumps are supplied with fluid through electric motor-operated firewall shutoff valves controlled from the cockpit.

The reservoir is pressurized to provide an adequate supply of fluid to the pumps under all operating conditions. Fluid is filtered prior to entering a subsystem and enroute to the reservoir.

Annunciator lights warn of: 1) low fluid level in the reservoir; 2) low hydraulic flow; and 3) indicate when the system is pressurized.

The wheel brake system is hydraulically powered by a separate, completely independent hydraulic system.

MAJOR COMPONENTS

RESERVOIR

The reservoir (Figure 13-1) is mounted in the tail cone area on the engine carry-through beams. It is pressurized to 14 to 16 psi by hydraulic system pressure applied to a small piston in the reservoir neck. When the hydraulic system is not under pressure, an internal spring provides 2 to 4 psi pressure on the fluid.

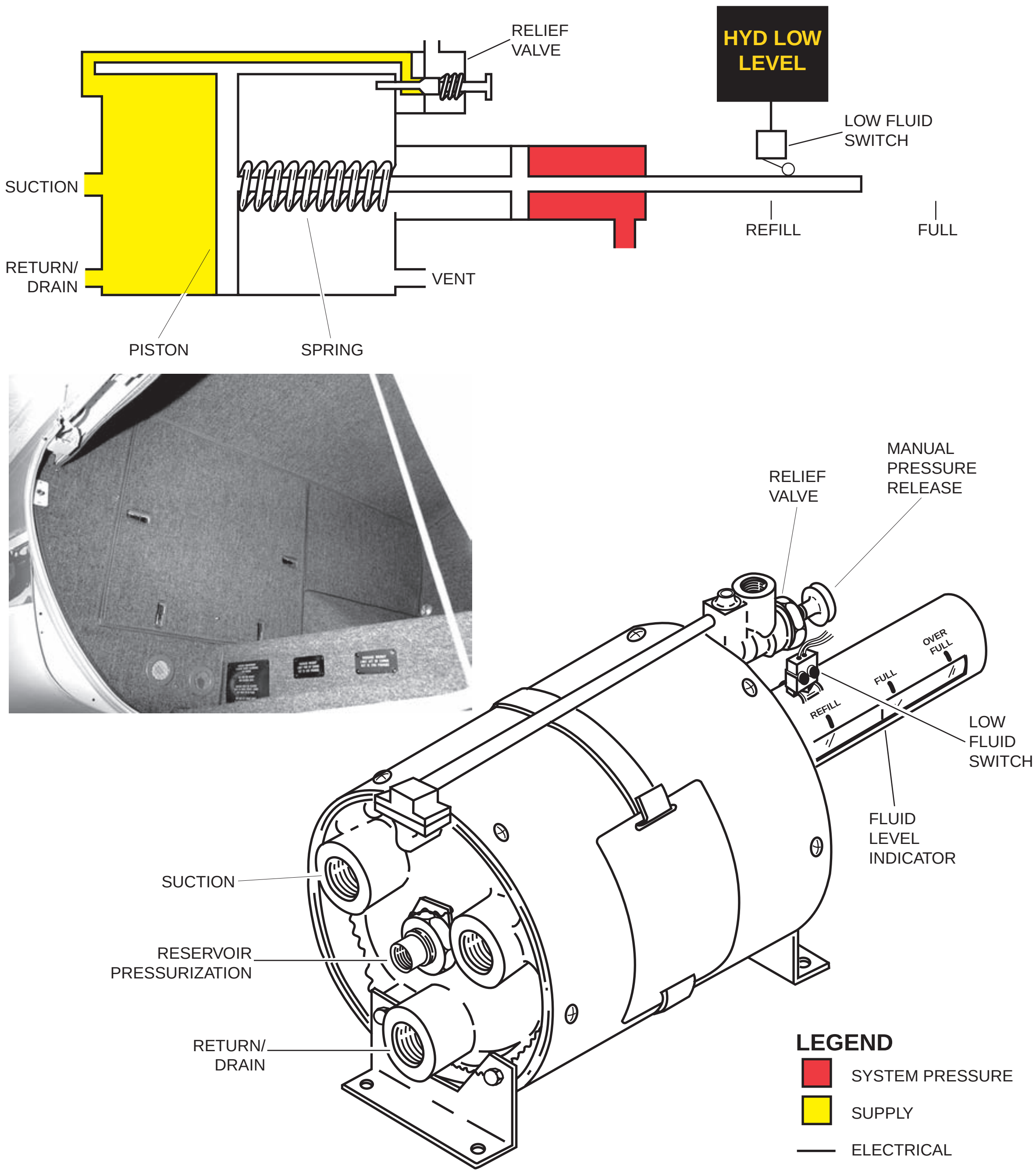


Figure 13-1. Hydraulic Reservoir

A visual fluid level indicator on the aft end indicates FULL when properly serviced with 0.5 gallon of fluid, OVERFULL at 0.6 gallon, or REFILL at 0.2 gallon. If the fluid level drops to 0.2 gallon, the amber HYD LOW LEVEL annunciator illuminates. Checking reservoir fluid level is a preflight inspection item. A relief valve on top of the reservoir opens at approximately 25 psi to prevent overpressurization. Bleeding or relieving an overfill condition is accomplished by opening the valve. Excess fluid is relieved overboard through the drain mast.

To service the reservoir, pressurizing equipment such as a hydraulic mule or hand-operated pump must be used. Servicing connections are provided on the right underside of the fuselage below the right engine (Figure 13-2).

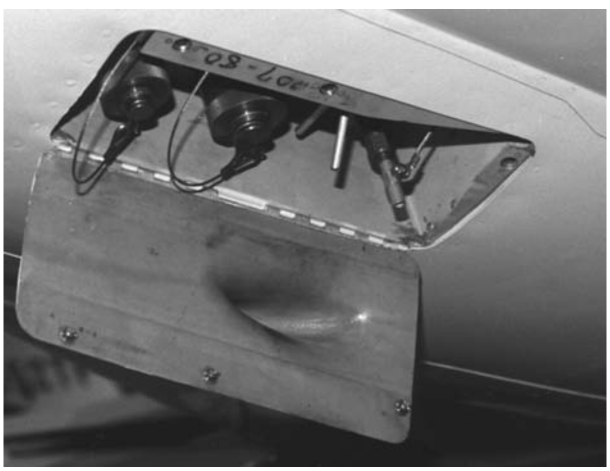


Figure 13-2. Hydraulic Servicing Connections

PUMPS

Hydraulic pressure is provided by a positive displacement engine-driven pump on each engine accessory case. Either pump is capable of supplying enough pressure to operate the gear, flaps, speedbrakes, and thrust reversers.

SYSTEM BYPASS VALVE

The solenoid-operated system bypass valve is the “heart” of the system. It is spring-loaded open to route pump output to the return line. When energized by selecting the operation of a subsystem, the valve electrically closes and hydraulic pressure is produced. If electrical power is interrupted, the valve fails “open.” A mechanical relief valve in parallel with the bypass valve maintains the system pressure at a maximum of 1,500 psi.

FIREWALL SHUTOFF VALVES

A hydraulic firewall shutoff valve is installed in the supply line to each hydraulic pump. The valves are electric motor operated and are controlled by ENG FIRE switchlights on the glareshield (Figure 13-3). The valves are normally kept open and are closed only in the event of an engine fire.

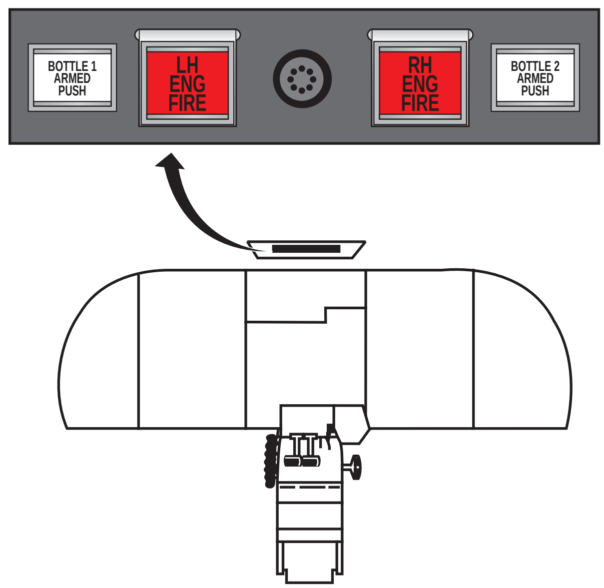


Figure 13-3. ENG FIRE Switchlights

FILTERS

The system incorporates three fluid filters, two for filtering fluid leaving the pumps and one for filtering return fluid prior to entering the reservoir. Each filter incorporates a bypass valve that opens at 100 psid if the filter element clogs. There is no cockpit indication of filter bypassing.

FLOW SWITCHES

A flow switch installed in each pump pressure line controls the HYD FLOW LOW LH/RH annunciator. As flow from a pump exceeds 1.33 gpm, a circuit opens to extinguish the LH or RH segment of the annunciator, as applicable. Decreasing the flow to 0.35–0.55 gpm closes the circuit, illuminating the annunciator. A check valve in the flow switch prevents backflow into the pump.

OPERATION

When an engine is started, the pump draws fluid from the reservoir through the normally open firewall shutoff valve (Figure 13-4). Pump output flow, through the flow switch, opens a circuit to extinguish the LH or RH segment of the HYD FLOW LOW light.

Assuming that no subsystem is being operated, the de-energized system bypass valve is open, bypassing pump output to return. As the second engine is started, the entire HYD FLOW LOW annunciator is extinguished.

When the operation of any subsystem is initiated, a circuit is completed to energize the system bypass valve to the closed position (closed center). As pressure increases, the HYD PRESS ON annunciator illuminates. System pressure is limited to 1,500 psi as the system relief valve opens. When the selected operation is completed, the circuit to the system bypass valve opens. The de-energized valve spring-loads to the open position, again bypassing pump output to return. The system depressurizes, and the HYD PRESS ON annunciator goes out. The system remains in the bypassing (open center @ 60 psi) condition until another subsystem is selected for operation.

When an engine is shut down, the applicable segment of the HYD FLOW LOW annunciator illuminates. With both engines shut down, the entire annunciator illuminates. Loss of a pump during system operation is indicated by illumination of the LH or RH segment, as applicable.

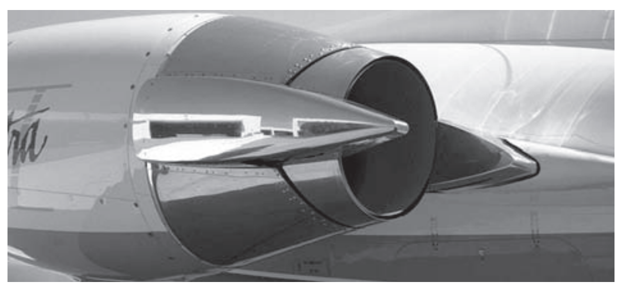
Depressing an ENG FIRE switchlight closes the hydraulic shutoff valve and the fuel shutoff valve for that engine. In addition, the generator is disconnected (tripped field relay) and the fire extinguishing system is armed. Closing of both the fuel and hydraulic firewall shutoff valves is indicated by illumination of the F/W SHUT OFF LH/RH annunciators.

THRUST REVERSERS

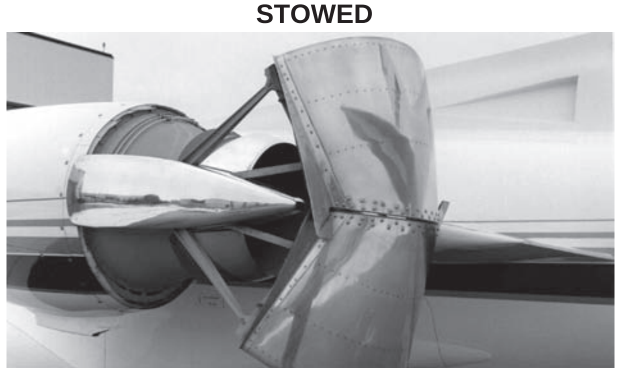
The Citation V ULTRA is equipped with hydraulically operated, electrically controlled, target-type thrust reversers (Figure 13-5) to assist deceleration during a landing roll.

When deployed, the reversers are maintained in position by hydraulic pressure.

In normal operation, hydraulic pressure is isolated when the reversers are stowed. They are maintained in the stowed position by an overcenter condition of the operating bar mechanism.



STOWED



DEPLOYED

Figure 13-5. Thrust Reversers

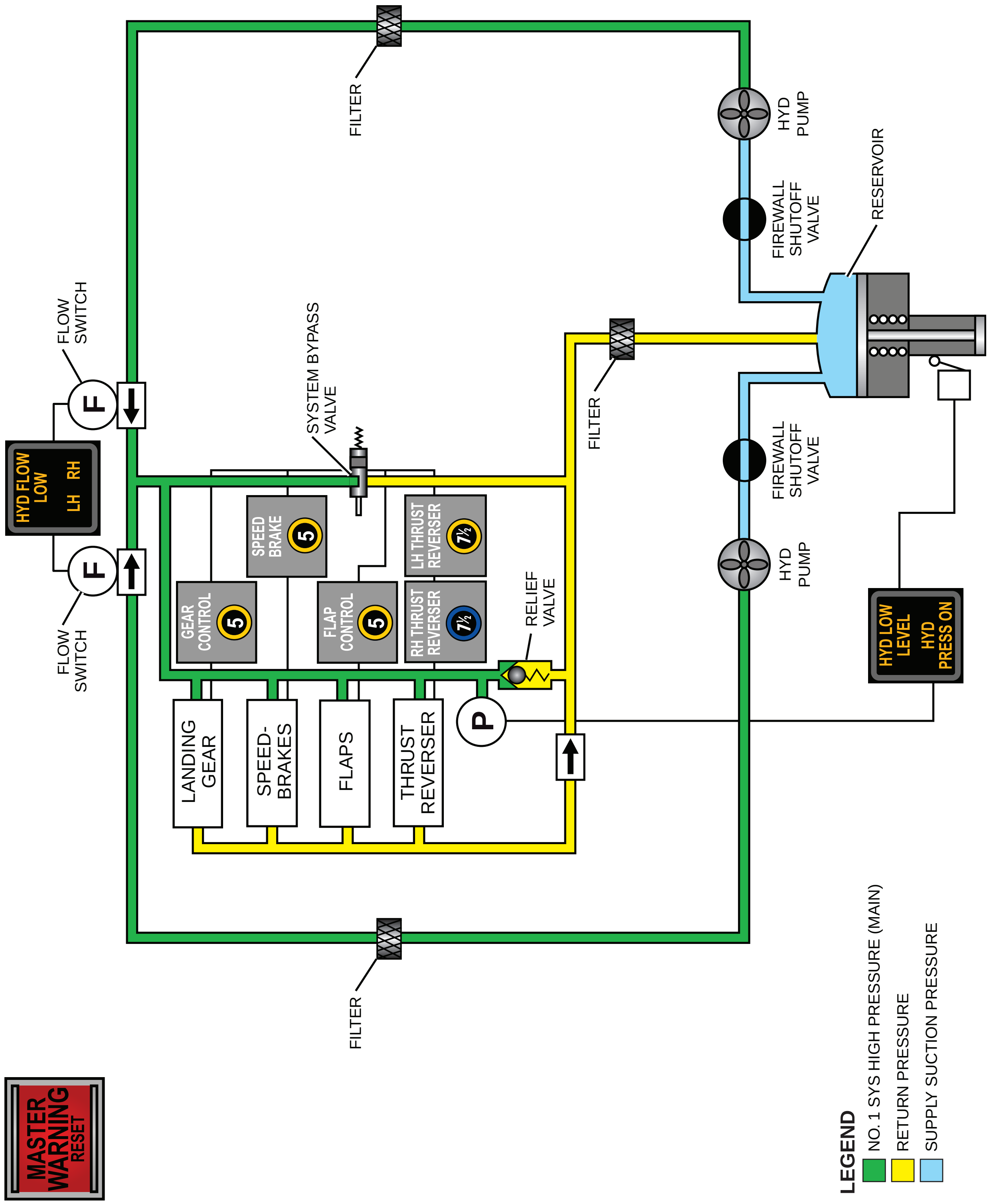


Figure 13-4. Hydraulic System Schematic

PROTECTION

A solenoid lock in the throttle quadrant prevents increasing engine reverse thrust rpm until the associated reverser reaches the fully deployed position.

A throttle feedback system moves the FCU lever and throttle to idle if the thrust reversers deploy inadvertently.

Thrust reverser operation is limited to ground operations only. The control circuitry is wired through the squat switches of the left and right main landing gear.

CONTROL

The thrust reversers are controlled by reverser levers piggyback-mounted on the throttles. Each reverser lever has three positions—full forward or stow, a detented reverse idle (deploy) position, and full aft or reverse thrust position.

When a reverser lever is moved to the reverse idle (deploy) position, the solenoid lock (mentioned earlier) prevents further aft movement until the reverser is fully deployed.

A microswitch in the throttle quadrant provides for electrical control. The switch is closed when the reverser lever is moved from the stow position, applying power to (1) close the hydraulic bypass valve and pressurize the hydraulic system, (2) open the thrust reverser isolation valve directing pressure to the reverser hydraulic system, and (3) energize the reverser control valve to deploy the buckets, providing a ground is provided by either squat switch (Figure 13-6).

INDICATION

Each reverser has three lights on the glareshield panel—ARM, UNLOCK, and DEPLOY (Figure 13-7). The amber ARM light circuit is completed by a pressure switch indicating that the hydraulic bypass valve is electrically closed, the isolation valve is electrically open and hydraulic pressure is available to the thrust reverser control valve.

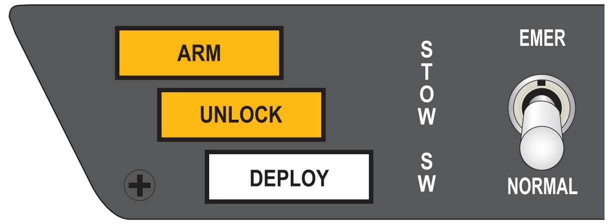


Figure 13-7. Emergency Stow Switches and Indicator Lights

In addition to the three reverser lights, the HYD PRESS ON annunciator illuminates to indicate that the hydraulic bypass valve is closed and the hydraulic system is pressurized.

The amber UNLOCK annunciator illuminates and the circuit is completed by a limit switch which closes when the reverser mechanism initially moves from the mechanically locked stow position.

The white DEPLOY annunciator indicates the reverser door mechanism has reached the fully deployed limit switch position.

Electrical power for the left thrust reverser is from the left extension bus and for the right thrust reverser from the right crossover bus.

OPERATION

After landing, when the throttles are at idle and the nose wheel is on the ground, raise the thrust reverser levers to the idle deploy detent. The ARM and HYD PRESS ON annunciator illuminate, followed almost immediately by the UNLOCK annunciator and then by the DEPLOY annunciator (within less than 1.5 seconds). Then the reverser lever solenoid lock releases. The reverser lever may now be moved aft to accelerate the engine if so desired. This last movement acts only on the FCU to increase thrust in reverse. The engine throttles themselves are held in idle by a mechanical interlock in the pedestal. While reverse thrust is

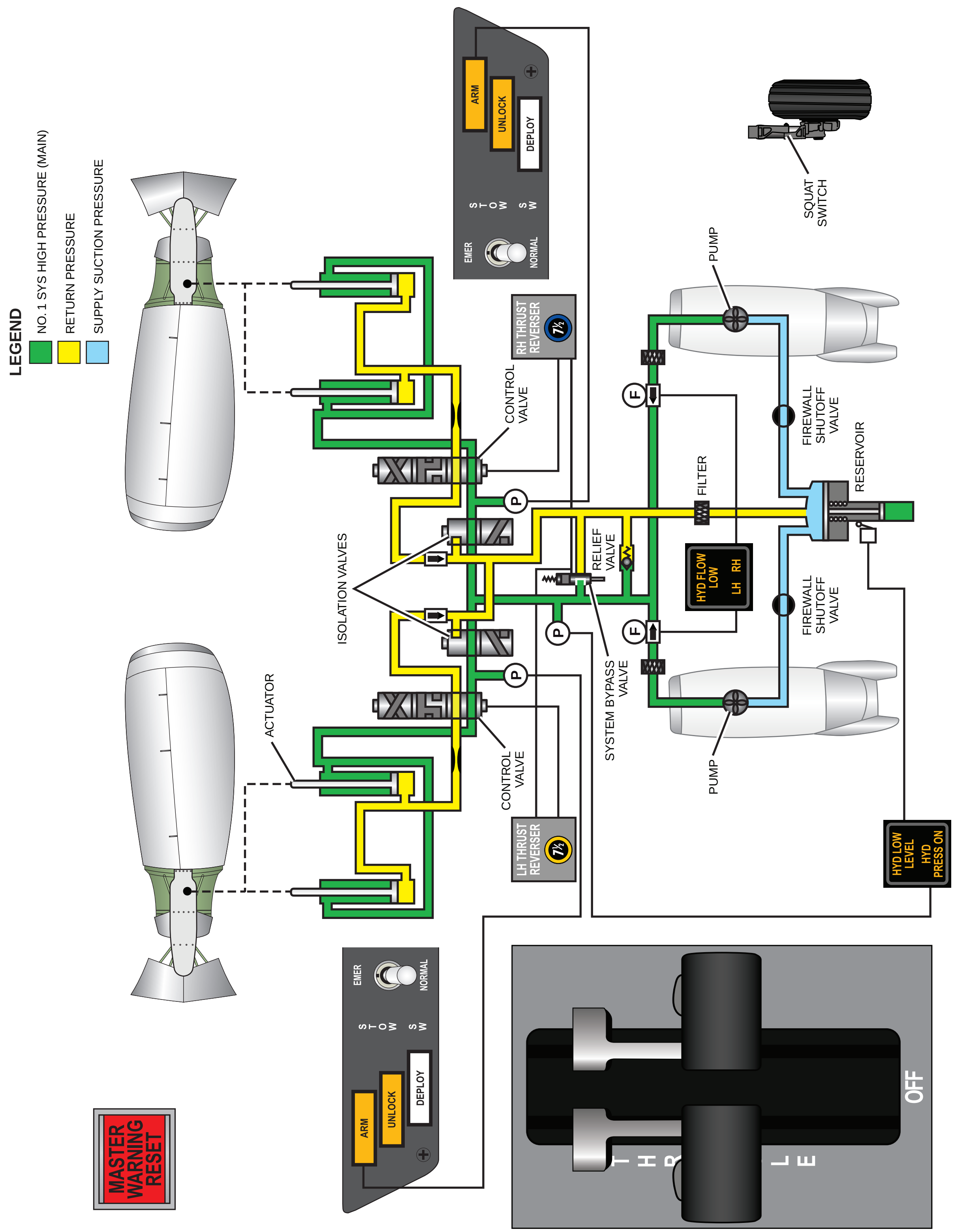


Figure 13-6. Thrust Reverser Operation

maintained, the ARM, UNLOCK, DEPLOY, and HYD PRESS ON annunciators remain on.

As the aircraft decelerates toward 60 KIAS, reverse thrust should be decreased to achieve idle reverse power at 60 knots. The thrust reverser indicating and HYD PRESS ON annunciators all remain on. Reverse idle may be maintained to assist further deceleration by drag and attenuation of thrust.

To stow the reverser, move the reverser lever fully forward and down. This energizes the control valve to the stow position, which directs hydraulic pressure to the stow side of the reverser actuators. The DEPLOY annunciator extinguishes, followed almost immediately by the UNLOCK, ARM, and HYD PRESS ON annunciators, indicating that the reverser doors are in the fully stowed position.

Figure 13-6 illustrates hydraulic operation of the thrust reverser system.

CAUTION

Do not attempt to move the engine throttles forward before the UNLOCK lights go out.

CAUTION

Deployment of the thrust reversers, especially at higher-than-normal landing speeds, causes a noseup pitching moment which must be countered by forward pressure on the control yoke. If not countered, this could lead to a “porpoise” and possible nosewheel damage.

CAUTION

The feedback system input to retard the throttle to idle must not be resisted by a friction knob setting that is too tight or by the pilot. This could result in throttle cable system damage.

WARNING

Do not attempt to fly the aircraft if the thrust reverser preflight check is unsuccessful.

WARNING

While the reverser is inadvertently deployed, the throttle must not be moved forward until the reverser is fully stowed. Overriding the feedback system while the reverser is deployed could result in a dangerous asymmetrical thrust condition and loss of performance.

EMERGENCY STOW

An emergency stow system is incorporated which bypasses the normal sequencing system. This system is used in case of an inadvertent deployment in flight or if the normal stow system fails.

Control

A two-position switch (Figure 13-7) for each reverser is located inboard of the reverser lights. The switch is labeled “STOW SW, EMER, NORM.” Moving a STOW Switch to the EMER position closes the hydraulic bypass valve and cause the control valve to energize to the stow position. If the reversers are deployed, the HYD PRESS ON light illuminates and the reverser lights extinguishes in the sequence DEPLOY and UNLOCK. The HYD PRESS ON light and the ARM light remains on continuously in the STOW position, holding the reversers STOWED with continuous hydraulic pressure (mechanical, overcenter stow locks may be inoperable). This system is tested before each flight following a normal deploy cycle.

If either an ARM or UNLOCK light illuminates in flight, the master warning system also come on.

NOTE

For all normal and emergency procedures, see the *Airplane Flight Manual*.

The LH thrust reverser uses left main DC from the LH thrust reverser circuit breaker for normal STOW–DEPLOY operation but uses power from the right main DC through the RH thrust reverser circuit breaker for emergency stow.

If a fire switchlight is pushed for engine fire, the isolation valve is deenergized closed and that engine reversers cannot be hydraulically deployed.

OTHER HYDRAULIC SUBSYSTEMS

Hydraulically powered subsystems include landing gear, speedbrakes, flaps, and thrust reversers. Application of hydraulic power to these subsystems is presented in Chapter 14—“Landing Gear and Brakes,” and in Chapter 15—“Flight Controls.”

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QUESTIONS

1. The system bypass valve is:
   A. Spring-loaded closed
   B. Spring-loaded open
   C. Energized closed
   D. B and C

2. Depressing an ENG FIRE switchlight:
   A. Shuts off hydraulic fluid to the pump
   B. Trips the generator field relay
   C. Arms the fire extinguishing system
   D. All of the above

3. Closing of a hydraulic firewall shutoff valve is indicated by:
   A. A warning horn
   B. Illumination of the applicable segment of the F/W SHUT-OFF annunciator
   C. Illumination of the HYD PRESS ON annunciator
   D. None of the above

4. If electrical power is lost, the system bypass valve:
   A. Spring loads to the closed position
   B. Is not affected
   C. Spring loads to the open position
   D. None of the above

5. The hydraulic system provides pressure to operate the:
   A. Landing gear and speedbrakes only.
   B. Antiskid brakes, landing gear, and flaps.
   C. Speedbrakes, landing gear, thrust reversers, and flaps.
   D. Speedbrakes, landing gear, and wheel brakes.

6. The reservoir quantity indicator is:
   A. In the right forward baggage compartment
   B. On the copilot instrument panel
   C. On the right engine near the oil filter
   D. In the tail cone area

7. Reservoir fluid level below 0.2 gallon is indicated by illumination of the:
   A. HYD LOW LEVEL annunciator
   B. HYD PRESS ON annunciator
   C. LH or RH HYD LOW LEVEL annunciator
   D. LH or RH HYD FLOW LOW annunciator

8. Hydraulic system operation is indicated by illumination of the:
   A. HYD LOW LEVEL annunciator
   B. HYD PRESS ON annunciator
   C. LH or RH HYD LOW LEVEL annunciator
   D. LH or RH HYD FLOW LOW annunciator

9. Of the following statements concerning the hydraulic system, the correct one is:
   A. The HYD PRESS ON annunciator illuminates anytime the engine-driven pump operating.
   B. A HYD PRESS ON annunciator illuminating while the gear is extending may indicate a failed hydraulic pump.
   C. The HYD LOW LEVEL annunciator illuminates whenever reservoir fluid level is 0.5 gallon.
   D. A HYD FLOW LOW annunciator illuminating may indicate a failed hydraulic pump.

10. The thrust reversers:

A. May be deployed only when the throttles are in IDLE

B. Must have both EMER STOW switches in EMER for takeoffs to guard against inadvertent deployment during that critical phase of flight.

C. May be left in idle reverse until the aircraft is brought to a full stop

D. Both A and C

11. When normal deployment of the thrust reversers is obtained, the following annunciator lights should be illuminated:

A. ARM, UNLOCK, DEPLOY

B. DOOR NOT LOCKED, ARM, UNLOCK, DEPLOY

C. HYD PRESS ON, ARM, UNLOCK, DEPLOY

D. DOOR NOT LOCKED, HYD PRESS ON, DEPLOY

12. The incorrect statement regarding the use of thrust reversers is:

A. They may be used in flight to slow the aircraft.

B. They should not be used on touch-and-go landings.

C. The reversers must be in idle reverse by 60 KIAS.

D. Either squat switch on the ground allows both reversers to deploy.

13. The master warning lights:

A. Have nothing to do with the reverser system.

B. Will illuminate if an ARM light illuminates while in flight.

C. Will illuminate if the HYD PRESS ON light remains illuminated after the DEPLOY light is illuminated on the ground.

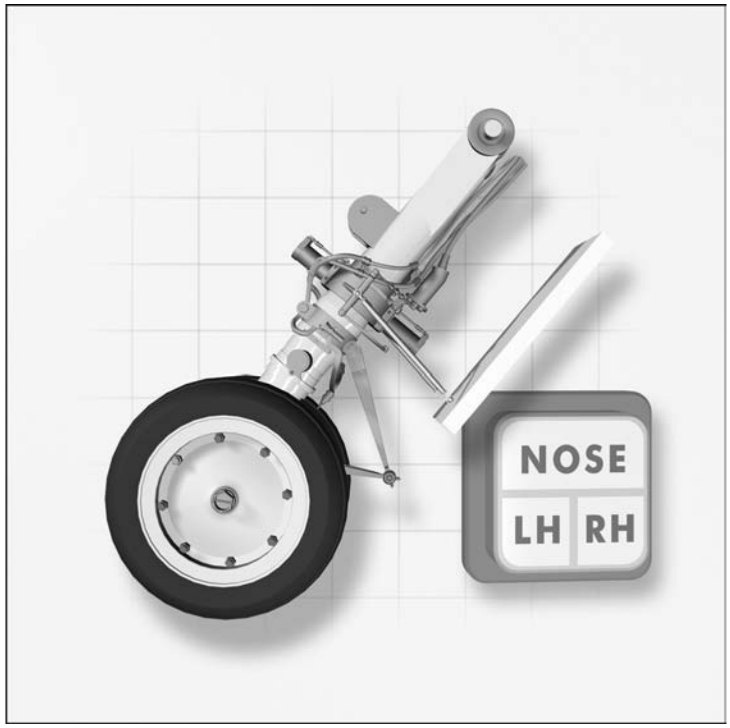
D. Will illuminate if a DEPLOY light illuminates in flight.

CHAPTER 14
LANDING GEAR AND BRAKES

CONTENTS

ILLUSTRATIONS

CHAPTER 14
LANDING GEAR AND BRAKES



INTRODUCTION

The Citation V Ultra aircraft landing gear is electrically controlled and hydraulically actuated. When retracted, the nose gear and the struts of the main gear are enclosed by mechanically actuated doors. The main gear wheels remain uncovered in the wheel wells. Gear position and warning are provided by colored indicator lights and a warning horn.

Nosewheel steering is mechanically actuated through linkage from the rudder pedals. A self-contained shimmy damper is located on top of the nose gear strut.

Power braking is provided with or without antiskid. Emergency braking is also provided.

GENERAL

Each inboard-retracting main gear utilizes two hydraulic actuators—one for gear actuation and one for uplock release. Two hydraulic actuators perform identical duties for the forward-retracting nose gear. An electrically positioned control valve directs hydraulic pressure for gear operation.

Gear position indication is provided by one red and three green position indicator lights on the landing gear control panel. In addition, a warning horn sounds when throttle or flap and gear position are not compatible.

The mechanically actuated nosewheel steering system is actuated by cable linkage from the rudder pedals. The system is enabled with the gear extended, on or off the ground. Nose gear centering is accomplished mechanically during retraction.

The power brake system utilizes a separate hydraulic system powered by an electrically driven pump. Each main gear wheel houses a multiple disc brake assembly that can be actuated by pressure from the electrically driven pump or stored air pressure during emergency braking. A parking brake is provided for parking the aircraft.

LANDING GEAR

The main and nose landing gear struts are conventional air-oil struts. Each strut has a floating piston with hydraulic fluid on one side and a nitrogen pressure charge on the other side for shock absorption during taxi, takeoff, and landing. A data plate on the strut contains information to determine the proper amount of visible chromed surface on the lower portion of the strut. The landing gear is normally hydraulically actuated but can be mechanically and pneumatically extended if the normal gear actuation system fails.

Main Gear

The main gear assembly (Figure 14-1) includes a strut, two hydraulic actuators, torque links, a taxi light (UNs 0297 and on, or UNs 0260–0296 with SB 560–33–12 incorporated), a single wheel with a multiple disc brake, and a squat switch that senses in-flight/on-ground conditions.

NOTE

Chrome showing strut extension should be between 1.4 and 4.0 inches.

The main gear is locked in the retracted position by a spring-loaded uplock actuator. Prior to extension, this uplock actuator must be released by hydraulic pressure before the hydraulic pressure can reach the main hydraulic actuator to extend the gear. When the gear is extended, an internal locking mechanism within the main gear actuator engages the mechanical locking ring (Figure 14-2).

Figure 14-1. Right Main Gear and Door

The downlock mechanism consists of a locking ring held in a groove on the actuator piston. It can be released only with hydraulic pressure applied to the retract side of the actuator; therefore, no external downlock pins are required.

A door actuated by gear movement covers the main gear strut when retracted; the tire/wheel fairs into the wheel well and is not covered.

Each main gear wheel incorporates a fusible plug that melts to deflate the tire if excessive tire pressure is generated by an overheated brake.

Nose Gear

The nose gear assembly (Figure 14-3) includes a strut, two hydraulic actuators, torque links, a single wheel, and a self-contained shimmy damper.

NOTE

Chrome showing strut extension should be between 1.2 and 5.0 inches.

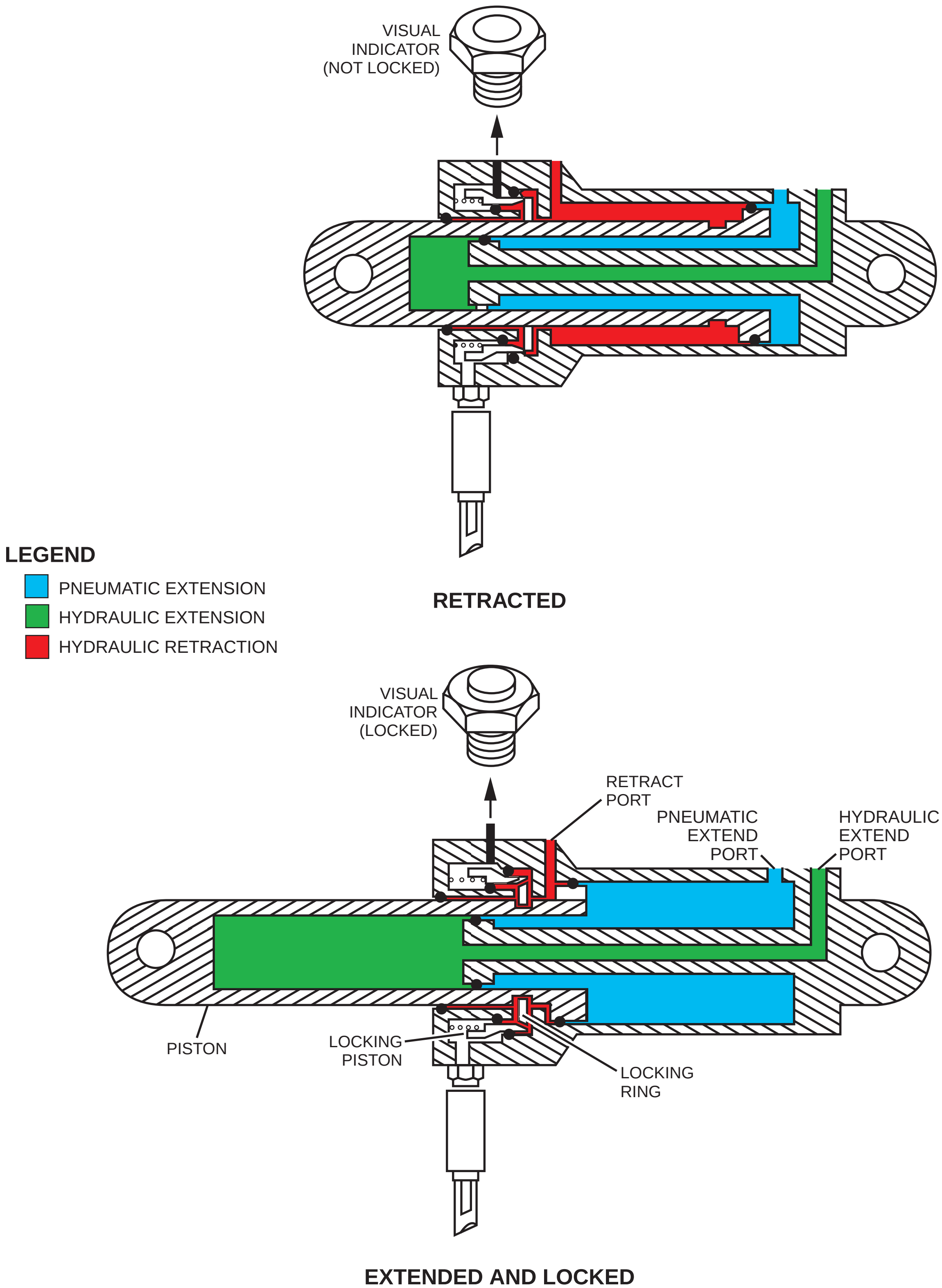


Figure 14-2. Main Landing Gear Actuator

Figure 14-3. Nose Landing Gear and Doors

The nose gear is held in the retracted position by a spring-loaded uplock mechanism that is released by a hydraulic actuator prior to gear extension. When the gear is extended, an internal locking mechanism in the gear actuator engages to lock the gear down. This locking device is similar to the one in the main gear actuator. No external downlock pin is required for the nose gear. The nose gear is mechanically centered prior to retraction.

Three doors are actuated by nose gear movement to completely enclose the nose gear and wheel at retraction. The two forward doors are closed with the gear extended or retracted, and are open only during gear transit. The aft door remains open with the gear extended.

Nosewheel Spin-Up System

An optional gravel runway system is available to reduce gravel spray at nosewheel touchdown. On aircraft so equipped, the nosewheel spinup is initiated by positioning the W/S BLEED air switch to either the LOW or the HI position, the WINDSHIELD BLEED AIR valve controls to OFF, and the NOSE WHEEL SPIN-UP control to ON (Figure 14-4). This directs engine bleed air to the system for wheel spin-up.

Within 90 seconds, the N/W RPM indicator should illuminate green as wheel speed increases into the normal rpm range. Maintain wheel speed within this range by adjusting the NOSE WHEEL SPIN-UP control. Overspeed is indicated by the N/W RPM indicator changing from green to red. The pilot's (left) WINDSHIELD BLEED AIR valve control may be turned on during approach if rain removal or anti-icing is desired; however, wheel acceleration rate will be reduced. As the nosewheel touches down, position the NOSE WHEEL SPIN-UP control to OFF.

During operation of the spin-up system, engine power should be above 60% N_2 to ensure adequate bleed air.

Nosewheel Steering Disengage System (Gravel Mod)

Landing with the nosewheel not centered at touchdown (crosswind landings) or large nosewheel steering inputs at high speed may cause the nosewheel to deflect gravel into the engine opposite the rudder input. A nosewheel steering disengage system is provided to disengage the nosewheel steering from the rudder pedals thus allowing full rudder pedal movement without nosewheel steering input.

The nosewheel steering GRAVEL T-handle, to the right of the center pedestal, is pushed down to engage rudder steering input to the nose strut (locked).

The GRAVEL T-handle is pulled out to disengage the rudder steering inputs to the nose strut (unlocked). The nose gear strut/wheel is mechanically held centered for takeoff and landing in gravel.

The nose steering disconnect system is spring-loaded to the engaged position when the nosewheel steering, GRAVEL T-handle is unlocked (pulled).

Consult the *Airplane Flight Manual* Supplement on Gravel Runway Modification for normal and emergency operating procedures, landing gear speeds, takeoff performance, and steering techniques.

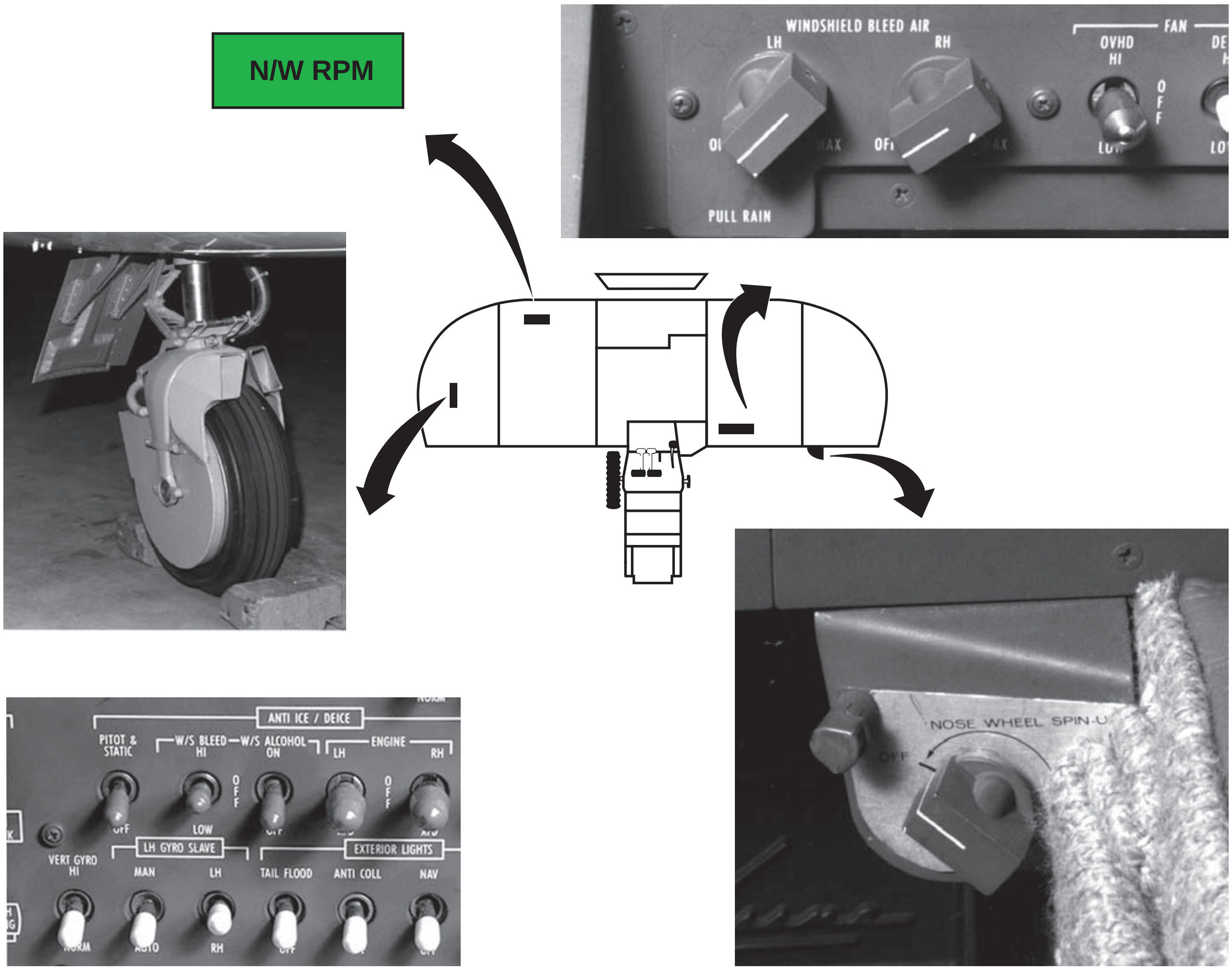


Figure 14-4. Nosewheel Spin-up System

CONTROLS AND INDICATORS

The landing gear is controlled by the LDG GEAR control handle to the left side of the center panel (Figure 14-5). Gear position is shown by one red and three green indicator lights on the gear control panel. A warning horn provides warning of abnormal conditions.

Controls

The LDG GEAR control handle actuates switches to complete circuits to the extend or retract solenoid of the gear control valve. On the ground, a spring-loaded plunger holds the handle in the DOWN position, preventing inadvertent movement of the handle to the UP position (Figure 14-6). The DC power for the gear position indicator lights, warning horn, and the locking solenoid on the gear handle is through the LDG GEAR circuit breaker on the left main extension bus located on the left circuit-breaker panel. (This circuit breaker is in the WARNING section of the panel and should not be confused with the GEAR CONTROL circuit breaker in the SYSTEMS section of the same panel.)

Airborne, with the left main gear squat switch in the in-flight position, the locking solenoid is energized to retract the plunger. This frees the handle for movement to the UP position. This safety feature cannot be overridden. If the

Figure 14-5. Landing Gear Control Panel

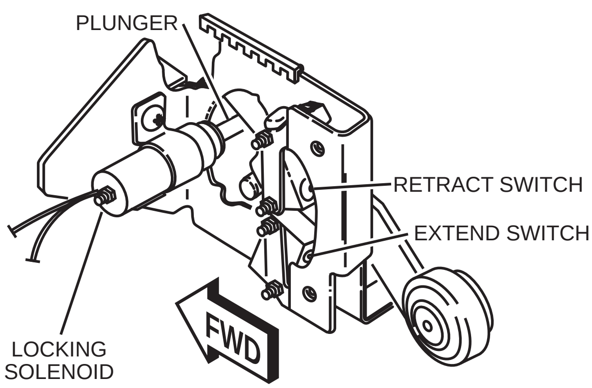


Figure 14-6. Landing Gear Handle Locking Solenoid and Switches

solenoid fails or electrical power is lost, the gear handle cannot be moved to the UP position.

The gear handle must be pulled out of a detent prior to movement to either the UP or DOWN position.

Indicators

The green NOSE, LH, and RH lights on the gear control panel indicate gear down and locked. As each gear locks down, its respective green light is illuminated.

The red GEAR UNLOCKED light indicates an unsafe gear condition. It illuminates when the gear handle is moved out of the UP detent and remains on until all three gear are down and locked. At retraction, the light comes on when any downlock is released and remains on until all three gear are up and locked.

Normal indication with the gear down is three green lights illuminated. All lights should be out with the gear retracted.

Figure 14-7 shows indicator light displays for various gear positions. The GEAR UNLOCKED light and warning horn can both be tested by positioning the rotary TEST switch to LDG GEAR.

Warning Horn

A warning horn sounds if one or more gear are not locked down, one or both throttles are retarded below 70% N_2 rpm, and airspeed is below 150 KIAS. The horn can be silenced by depressing the HORN SILENCE PUSH button on the gear control panel (Figure 14-5).

The warning horn also sounds if flaps are extended beyond 15° with one or more gear not down and locked regardless of any other condition. Under these conditions, the horn cannot be silenced.

OPERATION

In addition to energizing the gear control valve, LDG GEAR handle movement to the UP or DOWN position also closes the hydraulic system bypass valve, creating pressure as indicated by illumination of the HYD PRESS ON annunciator. At the completion of either cycle, the bypass valve opens and the HYD PRESS ON annunciator goes out.

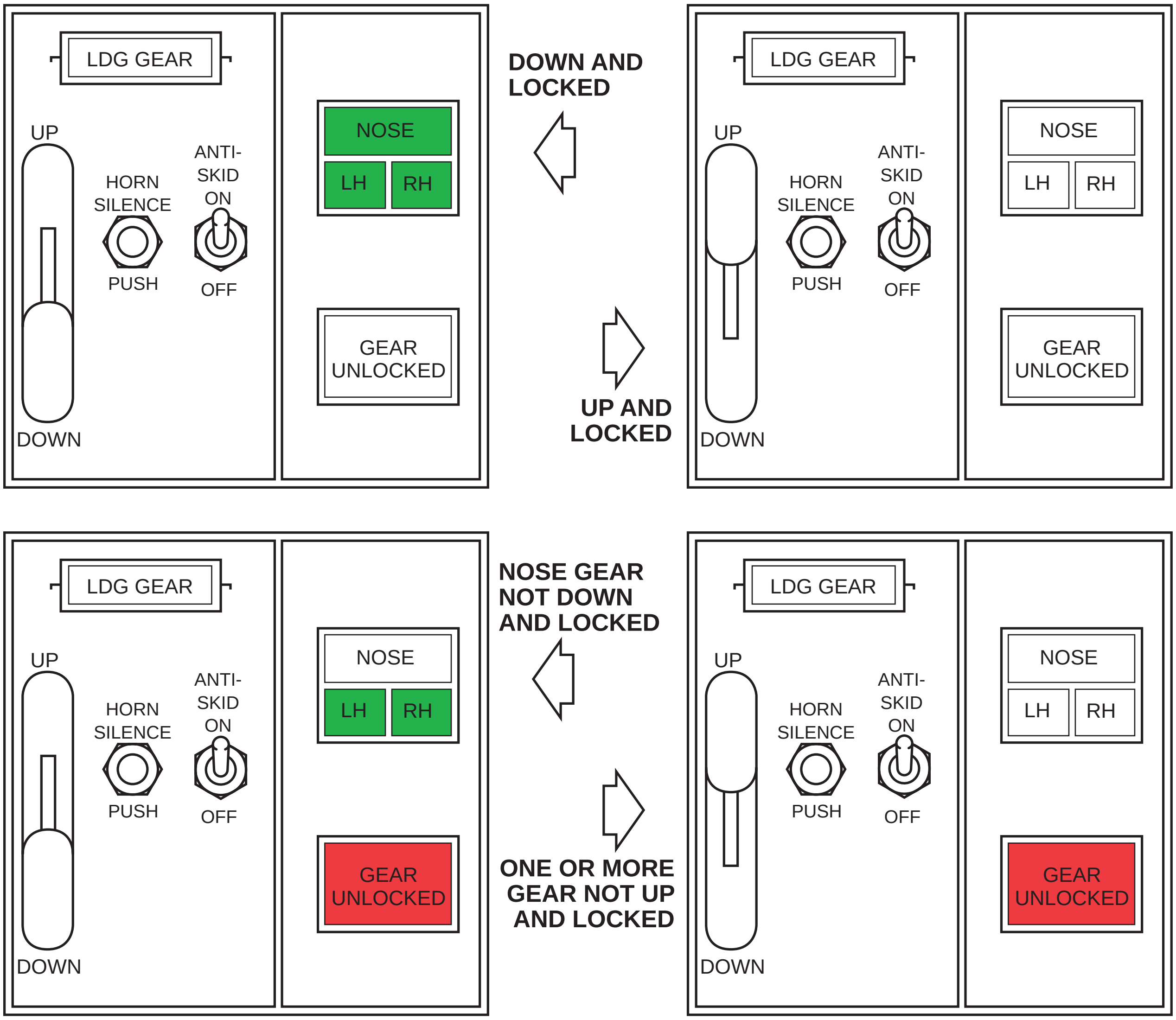


Figure 14-7. Gear Position Indications

The DC power for the landing gear control circuit is through the GEAR CONTROL circuit breaker located in the SYSTEMS section of the main extension bus of the left circuit-breaker panel.

Retraction

Placing the LDG GEAR handle in the UP position energizes the retract solenoid of the gear control valve. The control valve is positioned to direct pressure to the retract side of each gear actuator and to preload the uplocks. The downlock mechanism in each actuator releases and retraction begins (Figure 14-8).

As each gear reaches the fully retracted position, it is engaged by a spring-loaded uplock mechanism, and an uplock switch is actuated. When all three uplock switches have been actuated, the gear control valve circuit is interrupted and the valve returns to the neutral position. All position indicator lights on the control panel are out.

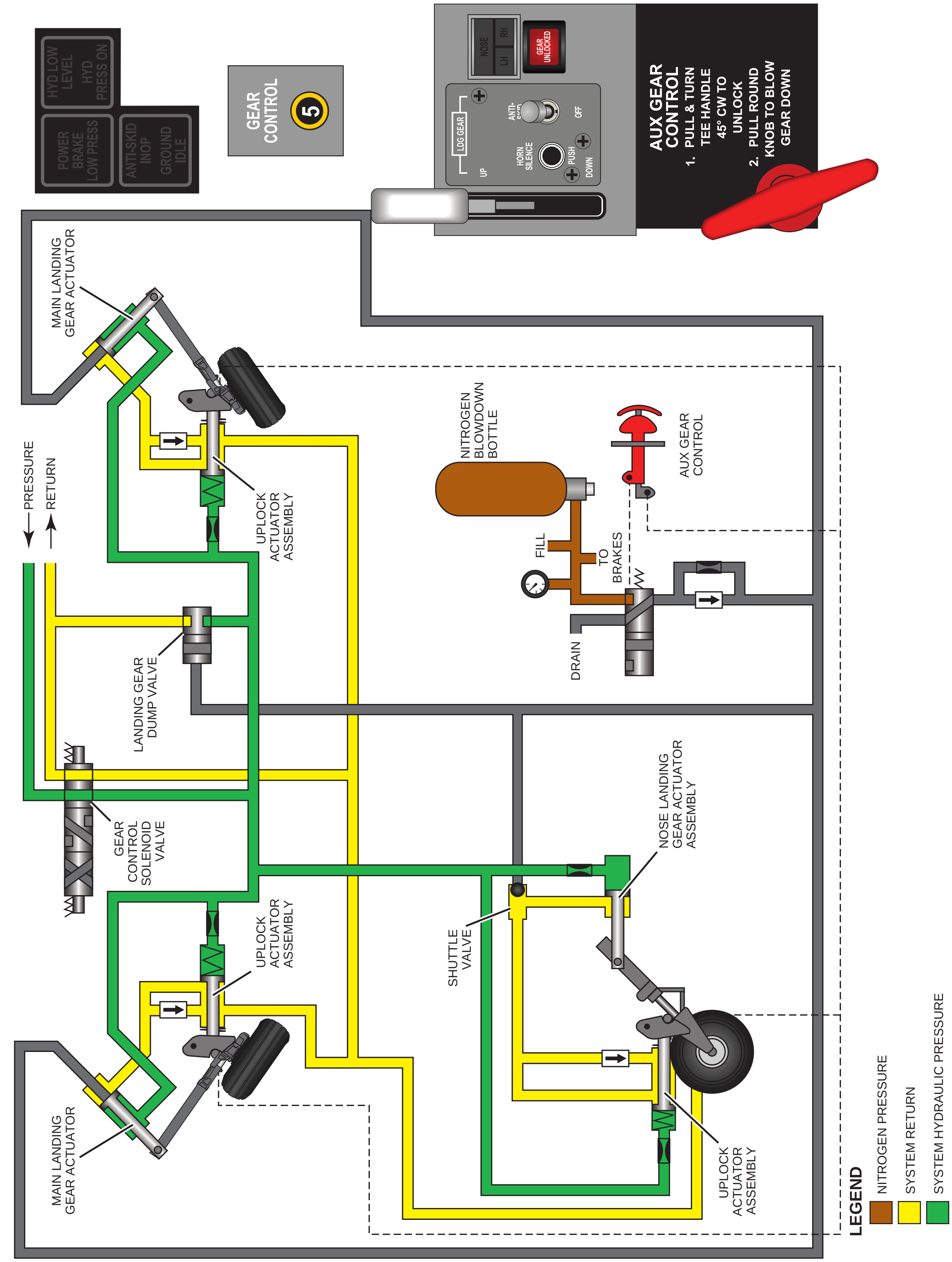


Figure 14-8. Landing Gear Schematic—Retraction

Extension

Placing the LDG GEAR handle in the DOWN position energizes the extend solenoid of the gear control valve (Figure 14-9). The valve is positioned to direct pressure to the uplock actuators, releasing the gear uplocks. When the uplocks have released, pressure continues to the gear actuators. As each gear reaches the fully extended position, a downlock switch is actuated. When all three downlock switches are actuated, the control valve circuit is interrupted and the valve returns to the neutral position. With pressure no longer being applied to the gear actuator, the internal locking mechanism within each actuator assumes the downlocked position, as indicated by extension of the downlock visual indicator pins (see Figure 14-2) and illumination of the green NOSE, LH, and RH position indicator lights on the gear control panel.

Emergency Extension

If the hydraulic system fails or an electrical malfunction exists in the landing gear system, the gear uplocks can be manually released for gear free fall. An air bottle which is charged to 1,800 to 2,050 psi is located in the right nose baggage compartment. This bottle is used for gear downlocking.

Emergency extension is initiated by pulling the AUX GEAR CONTROL T-handle and rotating clockwise (Figure 14-10). This mechanically releases the gear uplocks, allowing the gear to free fall. If necessary, use the rudder to yaw the aircraft, first in one direction, then the other to fully extend the main gear actuators. After the gear has extended, pull the round knob behind the T-handle. This releases air bottle pressure to the gear actuators and, at the same time, opens a dump valve to assure a path for fluid return to the reservoir and to inhibit any further hydraulic operation of the gear. Air pressure drives the gear actuators to the fully extended position where they are maintained by the internal lock mechanism in each actuator. Once the air bottle has been actuated, hydraulic operation of the gear is not possible. Maintenance action is required after an emergency extension to restore normal operation of the landing gear. The optimum speed for this procedure is 150 KIAS or less with the flaps retracted.

NOSEWHEEL STEERING

Nosewheel steering is manually actuated through cables and mechanical linkage connected to the rudder pedals. Steering is operative with the gear extended; with the gear retracted, rudder pedal movement does not deflect the nosewheel.

Normally, steering is limited by rudder pedal stops to 20° nosewheel deflection either side of center. A spring-loaded bungee in the system provides additional wheel deflection via castering accomplished with application of differential engine power or braking. The nosewheel is mechanically centered for retraction.

For towing, ensure that the flight control lock is disengaged, and do not exceed 95° nosewheel deflection. If 95° is exceeded, the attachment bolts will be sheared with resultant loss of steering capability.

CAUTION

If the nosewheel steering bolts are sheared (indicated by loss of nosewheel steering with the rudder pedals), flight should not be attempted. This is due to the possibility of the nosewheel not remaining centered after takeoff even with the gear extended.

Flying the aircraft with an inoperative nosewheel steering system can also result in violent nosewheel shimmy.

Since the nosewheel deflects with rudder pedal movement anytime the gear is extended, the pedals should be centered just prior to nosewheel touchdown during a crosswind landing.

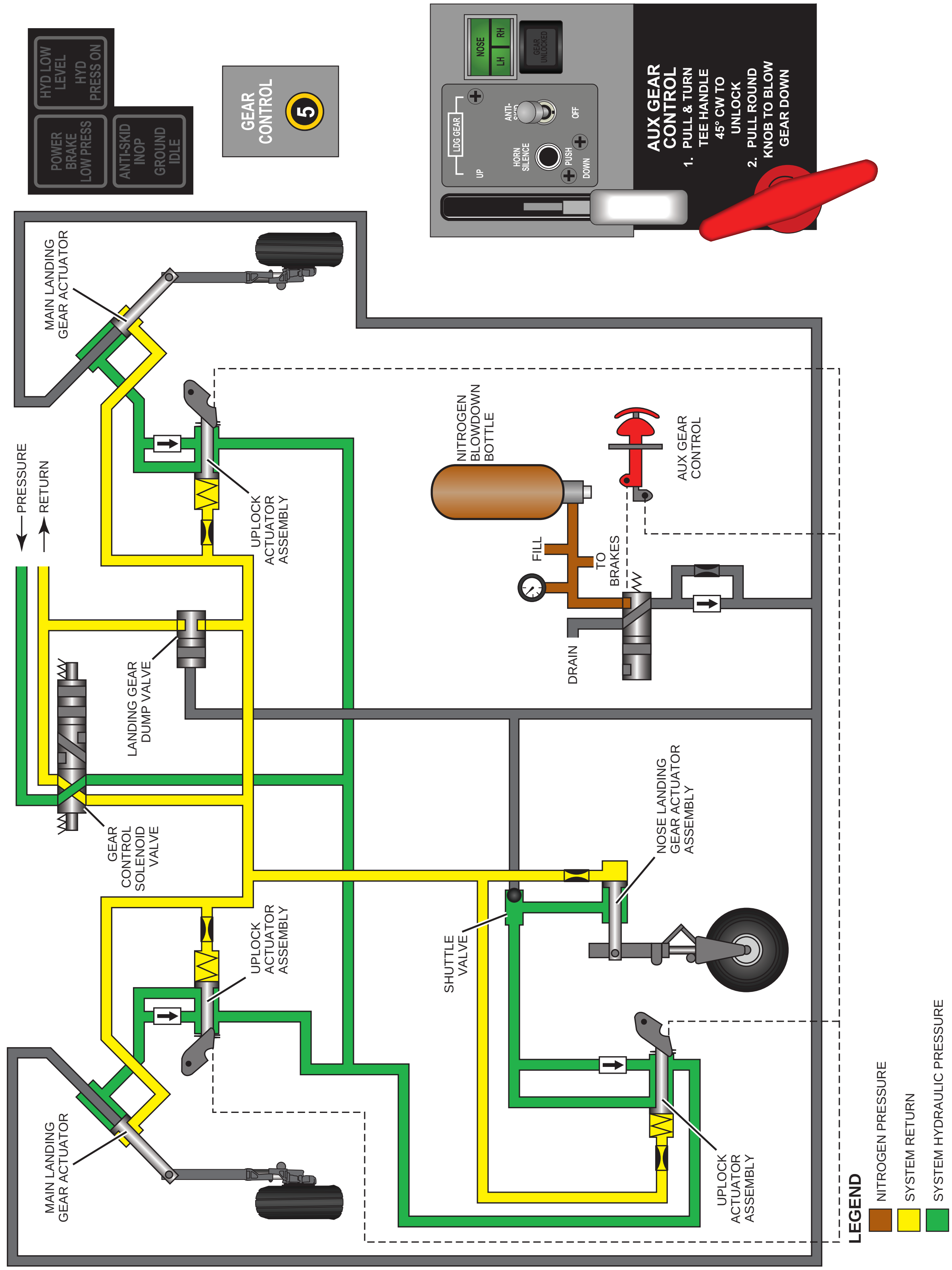


Figure 14-9. Landing Gear Schematic—Extension

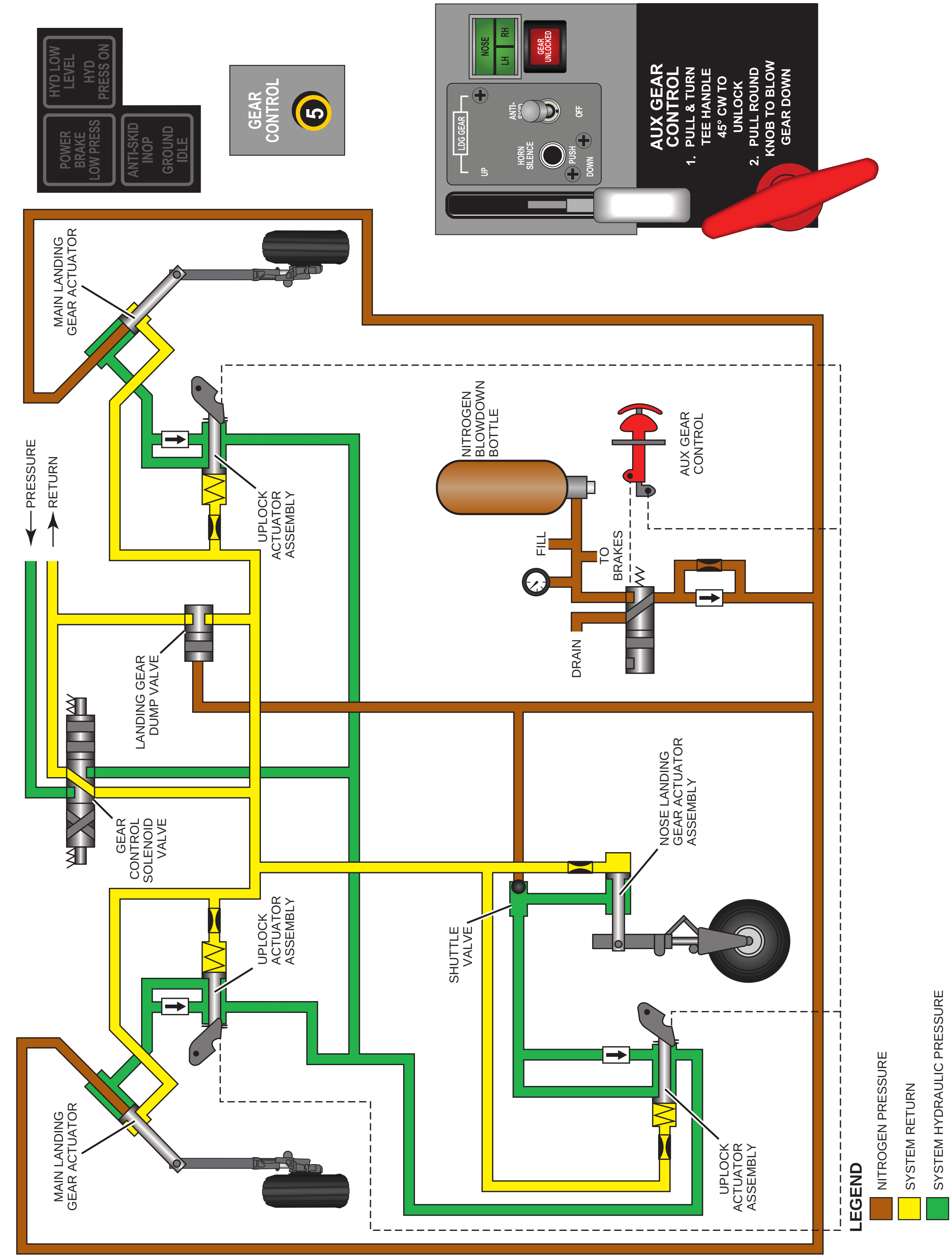


Figure 14-10. Landing Gear Schematic—Emergency Extension

BRAKES

The power brake system utilizes a multidisc brake assembly in each main gear wheel, powered by a hydraulic system that is completely independent of the aircraft hydraulic system. The system automatically maintains constant pressure for brake operation. The brakes are normally used as antiskid power brakes, but can be operated as power brakes without antiskid protection. In the event that brake system hydraulic pressure is lost, emergency braking is available.

Braking is initiated by rudder pedal-actuated master cylinders. If both the pilot and copilot attempt to apply the brakes simultaneously, the one applying the greater force on the rudder pedals has control since they are plumbed together in series.

System components include a hydraulic accumulator and a reservoir pressurized by cabin air. Reservoir fluid level and accumulator air precharge are exterior inspection items.

Use of the digital antiskid system permits maximum braking without wheel skid under all runway conditions. A speed transducer in each main gear wheel transmits wheel speed signals to an electronic control box. Detection of sudden deceleration of a wheel (impending skid) causes the control box to command the antiskid valve to reduce pressure being applied to the brakes. When the transducer signal returns to normal, braking pressure is restored to the brakes. Touchdown protection is a feature of the anti-skid system that prevents touching down with locked brakes. The wheels must be rotating (some speed transducer voltage) and weight-on-wheels (squat switch) for normal operation of the power brake and anti-skid system. A metering valve requires increased pedal force before metered pressure develops for smooth braking. Optimum braking is obtained by deployment of speedbrakes at touchdown, then firmly applying and holding the brakes until the desired speed has been reached. Do not pump the brakes. The digital anti-skid system monitors continuously for faults whether the gear handle is UP or DOWN and puts the "ANTISKID INOP" light ON if a fault occurs.

NOTE

The antiskid system is not operative with the parking brake set.

OPERATION

With the LDG GEAR handle DOWN and normal DC power available, a pressure switch controls the DC motor-driven hydraulic pump to maintain 900–1,300 psi for brake operation (Figure 14-11). An accumulator dampens pressure surges. The power brakes and anti-skid system receive DC power from the SKID CONTROL circuit breaker on the left main extension bus located on the left circuit-breaker panel.

The master cylinders are supplied with fluid from the brake reservoir. Depressing the brake pedals applies master cylinder pressure to actuate the power brake valve, which meters pump pressure to the brake assemblies in direct proportion to pedal force.

With the ANTI-SKID switch on the LDG GEAR panel in the ON position and a ground speed of at least 12 knots, maximum braking without wheel skid is available. Any tendency of a wheel to rapidly decelerate (skid) is detected by the wheel speed transducer, and the antiskid valve is signaled to momentarily dump pressure from both brakes. As wheel speed returns to normal, dumping ceases and pressure is once again increased in the brake assemblies. When the wheel speed drops below approximately 12 knots, the antiskid function disengages.

Braking on each main wheel is controlled by the applicable master cylinder and pedal; therefore, differential braking is available.

The ANTI-SKID switch, located on the LDG GEAR control panel, is normally in the ON position. In the OFF position, the antiskid system is deactivated and the ANTISKID INOP annunciator is on. The power brakes receive DC power through the SKID CONTROL circuit

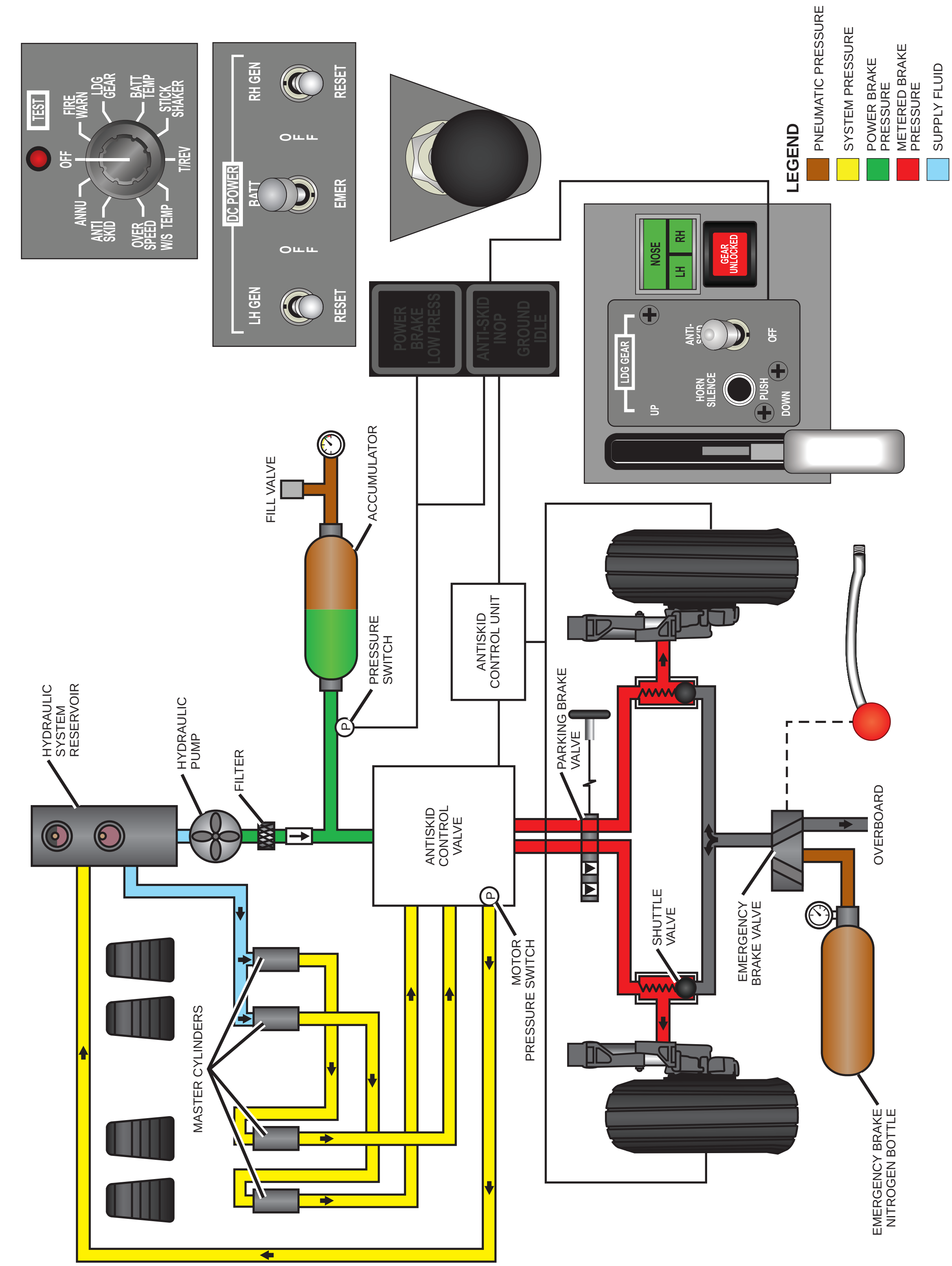


Figure 14-11. Power/Emergency Brake System

breaker on the left circuit-breaker panel when the left main extension bus is powered.

NOTE

The ANTI-SKID switch should not be turned on while the aircraft is taxiing.

If a fault develops in the antiskid system, the ANTISKID INOP annunciator light comes on, and the system should be switched off. Brake operation remains the same except that anti-skid protection is not available. When brake system pressure drops below 750 psi, the ANTISKID INOP and POWER BRAKE LOW PRESS annunciators will illuminate.

On the ground, test the antiskid system by momentarily selecting ANTISKID on the rotary TEST switch. The ANTISKID INOP light should illuminate, then go out in approximately three to four seconds. Airborne test of the system is automatically accomplished when the LDG GEAR handle is placed DOWN. Results should be the same as those obtained during the on-ground test. If the antiskid system fails the self-test, the ANTISKID INOP light will remain illuminated.

The digital anti-skid control module incorporates test circuitry which continually monitors the anti-skid system. If a fault is detected, the ANTI-SKID INOP light will illuminate on the annunciator panel. Certain faults in the system are displayed on the built-in test equipment (BITE) indicator (fault display unit), which is located under a panel on the left aft bulkhead of the nose baggage compartment. A white flag may appear in any of the five circular indicators located in a row on the fault display unit. The faults are left transducer failure (LEFT XDCR), right transducer failure (RIGHT XDCR), left and right squat switch disagreement (SQUAT DISAGREE), control valve failure (VALVE), and control unit failure (CONTROL).

The five circular magnetic indicators remain in view once activated and do not change if DC power is turned off.

Parking Brakes

The parking brakes can be set by applying the brakes in the normal manner, then pulling out the PARK BRAKE handle (Figure 14-12) on the left lower side of the pilot's instrument panel. This mechanically actuates the parking brake valve (see Figure 14-11), trapping fluid in the brakes. Release the parking brakes by pushing in the PARK BRAKE handle. Release the brakes before towing.

NOTE

Do not set the brakes subsequent to a hard stop. Brake heat transfer to the wheel could melt the fusible plugs, deflating the tire.

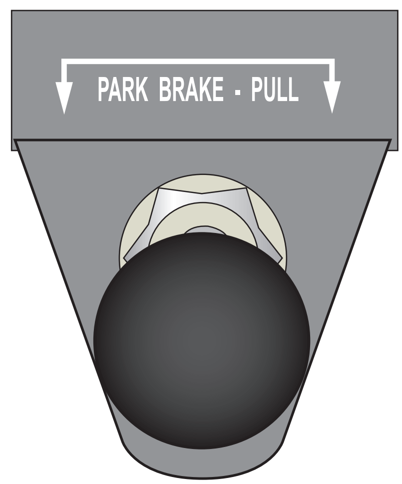


Figure 14-12. Park Brake Handle

EMERGENCY BRAKES

In the event the hydraulic brake system fails, a pneumatic brake system is available. The system uses air pressure from the pneumatic bottle which can also be used for emergency landing gear extension. Air bottle pressure is adequate for stopping the aircraft, even if the landing gear has been pneumatically extended.

Operation

Pulling the red EMER BRAKE PULL lever aft mechanically actuates the emergency brake valve. The valve meters air pressure through shuttle valves to the brake assemblies in direct proportion to the amount of lever movement.

Since air pressure is applied to both brakes simultaneously, differential braking is not possible. Returning the lever to its original position releases pressure from the brakes and vents it overboard, releasing the brakes.

NOTE

Do not depress the brake pedals while applying emergency air brakes. Shuttle valve action may be disrupted, allowing air pressure to enter the hydraulic lines and rupture the brake reservoir.

The emergency brakes should be applied only enough to obtain the desired rate of deceleration, then held until the aircraft stops. Repeated applications waste air pressure. Antiskid protection is not available during emergency braking. A full bottle provides approximately 10 brake applications or five applications after manual gear extension. Do not attempt to taxi after using the emergency brakes.

Maintenance action is required subsequent to emergency braking.

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QUESTIONS

1. On the ground, the LDG GEAR handle is prevented from movement to the UP position by:
   A. Mechanical detents
   B. A spring-loaded locking solenoid
   C. Hydraulic pressure
   D. A manually applied handle locking device

2. The landing gear uplock mechanisms are:
   A. Mechanically held engaged by springs
   B. Hydraulically disengaged
   C. Electrically engaged and disengaged
   D. A and B

3. Landing gear downlocks are disengaged:
   A. When hydraulic pressure is applied to the retract side of the gear actuators
   B. By action of the gear squat switches
   C. By removing the external downlock pins
   D. By mechanical linkage as the gear begins to retract

4. Each main gear wheel incorporates a fusible plug that:
   A. Blows out if the tire is overserviced with air
   B. Melts, deflating the tire if an overheated brake creates excessive tire pressure
   C. Is thrown out by centrifugal force if maximum wheel speed is exceeded
   D. None of the above

5. At retraction, if the nose gear does not lock in the up position, the gear panel light indication will be:
   A. Red light on, green LH and RH lights on
   B. Red light out, green LH and RH lights on
   C. Red light on, all three green lights out
   D. All four lights out

6. The gear warning horn cannot be silenced when one or more gear are not down and locked and:
   A. Flaps are extended beyond the 15° position.
   B. Airspeed is less than 150 KIAS
   C. Either throttle is retarded below 70% N_2 rpm
   D. Both throttles are retarded below 70% N_2 rpm and airspeed is not less than 150 KIAS

7. When the LDG GEAR handle is positioned either UP or DOWN:
   A. The bypass valve (in the hydraulic system) is energized open.
   B. The bypass valve is energized closed.
   C. The bypass valve is not affected.
   D. The HYD PRESS ON annunciator light goes out.

8. Emergency extension of the landing gear is accomplished by actuation of:

A. A switch for uplock release and application of air pressure.

B. One manual control to release the uplocks and apply air pressure for extension.

C. Two manual controls—one to mechanically release the uplocks, the other to apply air pressure for gear extension and downlocking.

D. None of the above.

9. Nosewheel steering is operative:

A. Only on the ground

B. With the gear extended or retracted

C. With the gear extended, in flight or on the ground

D. None of the above

10. The power brake valve is actuated:

A. Mechanically by the rudder pedals

B. Mechanically by the emergency airbrake control lever

C. Hydraulically by master cylinder pressure

D. Automatically at touchdown

11. Do not actuate the brake pedals while applying brakes with the emergency brake system because:

A. Air bubbles will be induced into the brake fluid.

B. The shuttle valve may allow air pressure into the brake reservoir, rupturing it or causing uncommanded differential braking.

C. The shuttle valve will move to the neutral position and no braking action will occur.

D. The brakes will be "spongy."

12. The DC motor-driven hydraulic pump in the brake system operates:

A. During the entire time the LDG GEAR handle is in the DOWN position.

B. As needed with the LDG GEAR handle DOWN in order to maintain system pressure.

C. Only when the POWER BRAKE LOW PRESS annunciator illuminates.

D. Even when the LDG GEAR handle is UP to keep air out of the system as the aircraft climbs to altitude.

13. Concerning the landing gear, the correct statement is:

A. The red GEAR UNLOCKED light will illuminate and the warning horn will sound whenever either or both throttles are retarded below 70% N_2 and the gear is up.

B. The gear warning horn can be silenced when the gear is not down and locked and the flaps are extended beyond 15°.

C. The landing gear pins must be inserted on the ground due to loss of hydraulic pressure as the engines are shut down.

D. The landing gear are secured in the extended position by mechanical locks.

14. Concerning landing gear auxiliary extension, the correct statement is:

A. If three green lights are observed after yawing the aircraft, it is not necessary to use the pneumatic bottle.

B. The optimum airspeed for this procedure is 150 KIAS.

C. The LDG GEAR handle is placed in the DOWN position to release the gear uplocks in order to allow the red T-handle to release the doors.

D. After the gear are extended by this procedure, they can be retracted in flight if the hydraulic system is returned to normal operation.

15. Concerning the landing gear, an ***incorrect*** statement is:

A. The AUX GEAR CONTROL is inoperative with loss of DC electrical power.

B. The pneumatic system should be used to assure positive locking of the actuators following a free-fall gear extension even though all three green lights are illuminated.

C. The LDG GEAR warning circuit breaker on the LH circuit-breaker panel controls the power to the landing gear position light, warning horn, and solenoid lock.

D. The GEAR CONTROL circuit breaker on the LH circuit-breaker panel controls the power to the landing gear control valve; if open, the gear cannot be extended or retracted normally.

16. The wheel brakes:

A. Will be inoperative with a HYD LOW LEVEL light illuminated.

B. Must be applied with the emergency system if a HYD LOW LEVEL light is illuminated.

C. Use a different type of approved fluid than the aircraft hydraulic system.

D. Are totally independent of the open center aircraft hydraulic system.

17. When the emergency brakes are used:

A. The EMER BRAKE PULL lever should be pumped in order to build up sufficient pressure to stop the aircraft.

B. The normal toe brakes must also be applied to allow the bottle pressure to reach the brakes.

C. Differential braking is not available.

D. Braking action will be insufficient if the gear has been extended pneumatically, since that process will exhaust the bottle pressure.

18. The parking brake:

A. May be set immediately after a maximum braking effort due to the modulation of the antiskid system.

B. Will still be operable if the emergency brakes have to be utilized.

C. Must be off to ensure proper operation of the antiskid system.

D. Has thermal relief valves to prevent the fusible plugs in the tire from melting.

CHAPTER 15
FLIGHT CONTROLS

CONTENTS

ILLUSTRATIONS

CHAPTER 15
FLIGHT CONTROLS

INTRODUCTION

The primary flight controls of the Citation V Ultra aircraft consist of ailerons, rudder, and elevators. They are manually actuated by rudder pedals and conventional control columns and can be immobilized by control locks when on the ground. Trim is mechanical in all three axes. Electrical elevator trim is also provided.

Secondary flight controls consist of flaps and speedbrakes, both powered by the hydraulic system. The angle-of-attack system warns of impending stalls by shaking the control columns and providing visual indication of angle of attack. Yaw damping is provided as a function of the autopilot.

PRIMARY FLIGHT CONTROLS

The ailerons, rudder, and elevators are manually operated by either the pilot or the copilot through a conventional control column and rudder pedal arrangement. Control inputs are transmitted to the control surfaces through cables and bellcranks. The rudder pedals can be adjusted to three separate positions for comfort by depressing a spring-loaded latch on the side of the rudder pedal.

A mechanical interconnection between the rudder and the ailerons provides small rudder deflections with aileron movement. A spring in the system can be manually overridden for cross controlling.

The rudder, both elevators, and the left aileron are each equipped with a trim tab mechanically actuated from the cockpit.

The elevator tabs can also be electrically positioned by pitch trim switches on the control wheels. The pilot switch has priority.

All flight control surfaces, including primary, secondary, and trim tabs, are illustrates in Figure 15-1.

CONTROL LOCK SYSTEM

Control locks, when engaged, lock the primary flight controls and both throttles. Prior to engaging the control locks, move both throttles to CUT OFF and neutralize the flight controls. Rotating the CONTROL LOCK handle 45° clockwise and pulling out until the handle returns to the horizontal position locks the flight controls in neutral and the throttles in CUT OFF (Figure 15-2).

To unlock the flight controls and throttles, rotate the handle 45° clockwise and push in until it returns to the horizontal position.

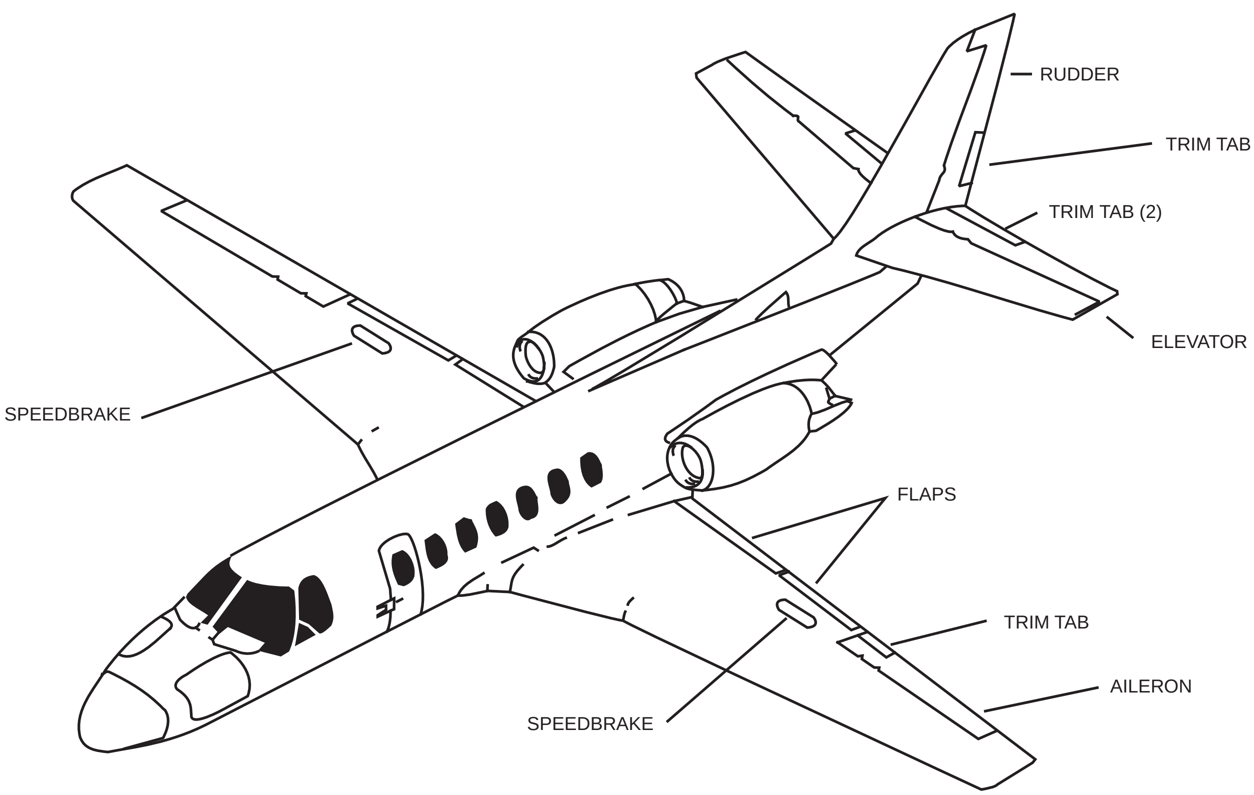


Figure 15-1. Flight Control Surfaces

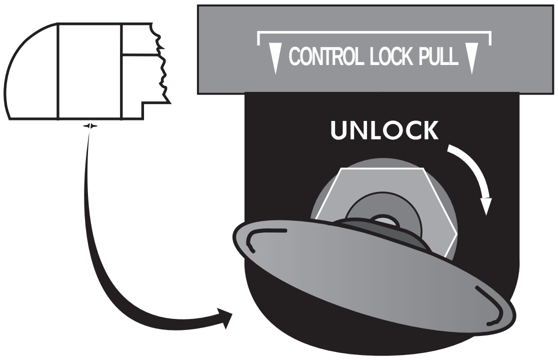


Figure 15-2. Flight Control Lock Handle

NOTE

Since the nosewheel steering and the rudder are mechanically connected through rudder pedal linkage, the aircraft must not be towed with the control locks engaged. To do so can damage the nosewheel steering system. The turning limits are ±60° with the control lock engaged. Do not fly the aircraft if the nosewheel steering is inoperative. This condition cannot be detected until steering is attempted during taxi.

TRIM SYSTEMS

Rudder and aileron trim are mechanical and are operated by cables from trim wheels in the cockpit. Mechanical and electrical trim are provided for the elevators and are controlled by a trim wheel on the pedestal and pitch trim switches on the control wheels.

RUDDER AND AILERON TRIM

Operation

Rudder or aileron trim is initiated by rotation of the aileron trim or rudder trim wheel on the pedestal (Figure 15-3). Cable systems transmit motion to position the tabs. A mechanical indicator adjacent to each trim wheel indicates direction of trim input. The rudder tab is a servo tab. It deflects at a rate half that of the rudder to aid the pilot in rudder deflection. It is the only servo tab on the aircraft.

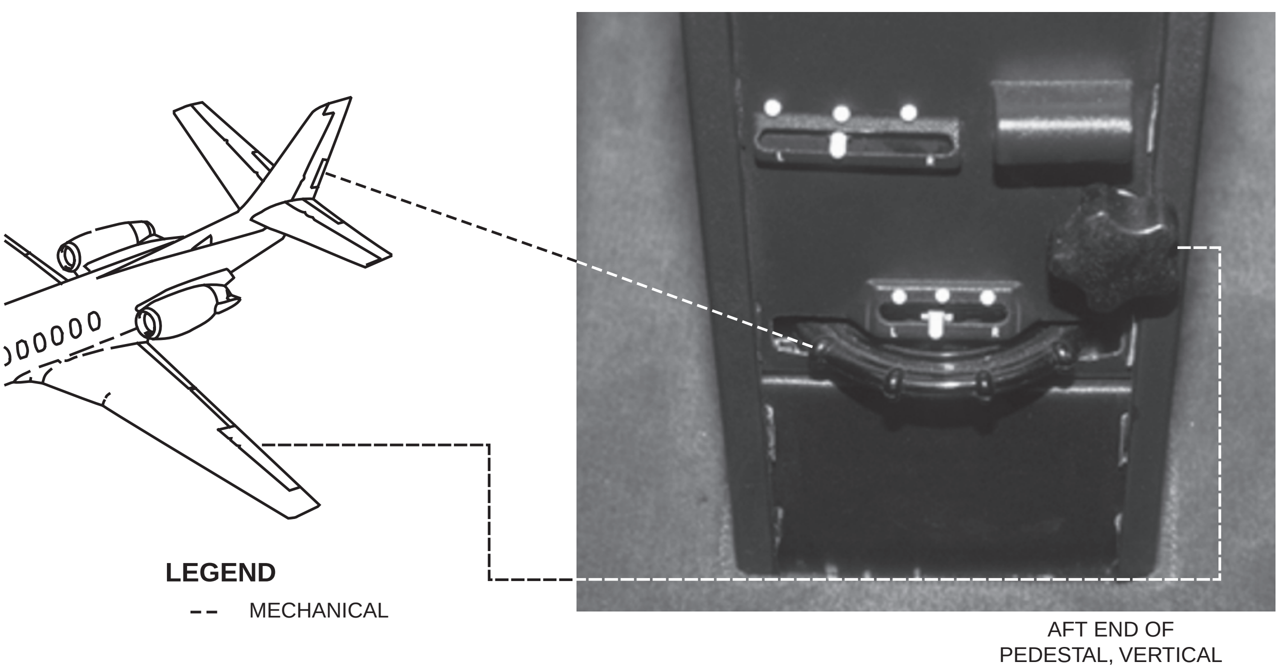


Figure 15-3. Rudder and Aileron Trim Systems

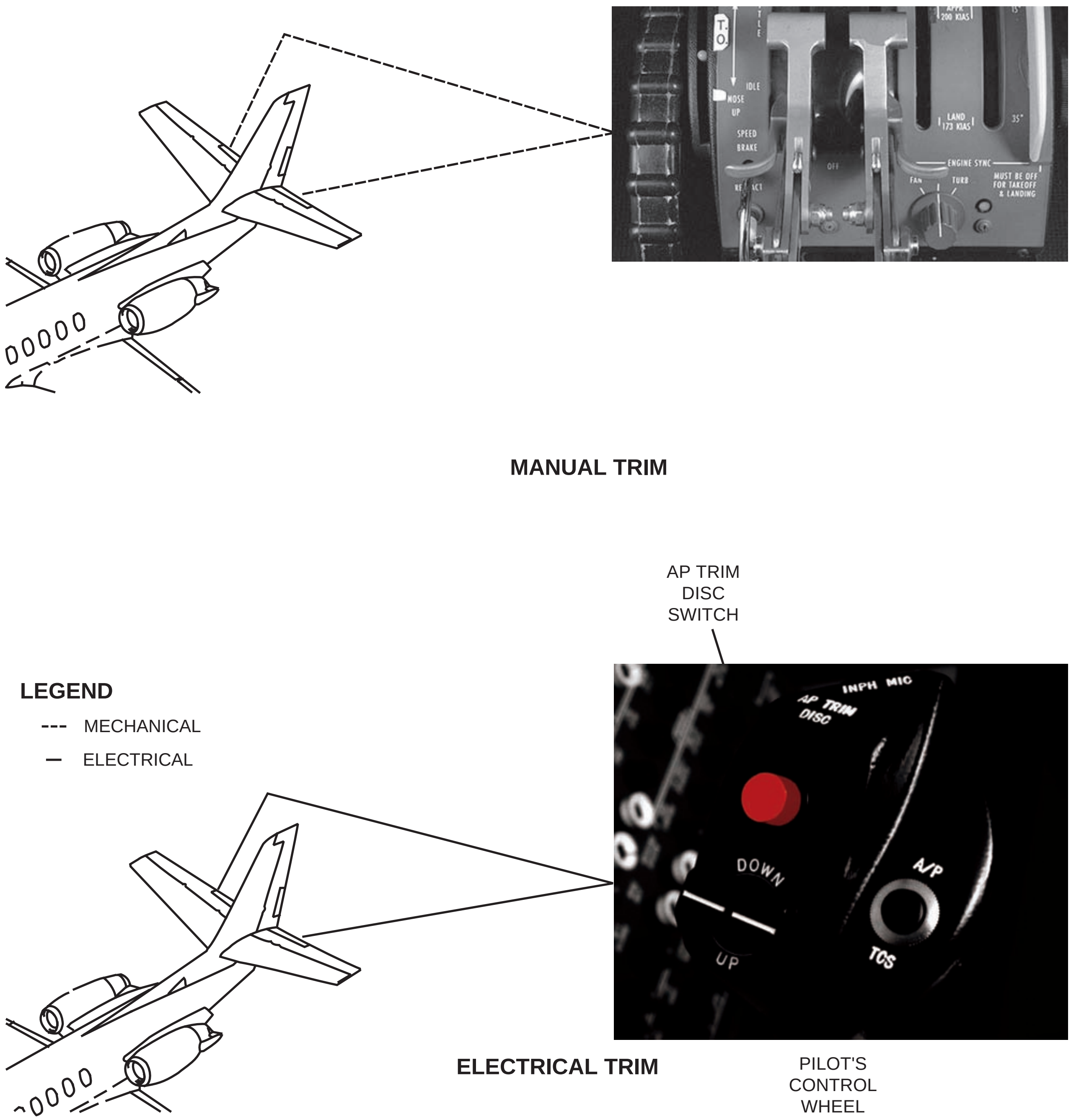


Figure 15-4. Elevator Trim System

ELEVATOR TRIM

Manual Trim

Manual elevator trim is initiated by rotating the elevator trim wheel (Figure 15-4). Motion is mechanically transmitted to position the elevator tabs. As the tabs move, a pointer on the elevator TRIM indicator moves toward the NOSE DOWN or NOSE UP position, as applicable.

Electrical Trim

Electrical trimming of the elevators is accomplished with a split-element trim switch on the outboard side of each control wheel (see Figure 15-4). Both elements of the switch must be moved simultaneously to complete a circuit to the electric motor trim actuator in the tail cone. The pilot pitch trim inputs override those made by the copilot.

As the trim switch is moved to the UP or DOWN position, the elevator tabs are positioned accordingly as indicated by the elevator TRIM indicator.

Prior to flight, the system can be checked for proper operation by moving both elements of the switch, in turn, in both directions, noting that trim occurs in the appropriate directions. Check for system malfunction by attempting to trim with one element of the switch. If trimming occurs, the system is malfunctioning and must be restored to normal operation prior to flight.

Runaway or malfunctioning trim can be interrupted by depressing the AP/TRIM DISC switch on the control wheel or stopped by pulling the PITCH TRIM circuit breaker on the left circuit breaker panel.

In addition to the pilot actuation of the elevator trim as discussed above, extension or retraction of the wing flaps between 15° and 25° causes the pitch trim to be electrically actuated by the flap linkage. This compensates for the pitch trim changes that occur due to extension or retraction of the flaps.

NOTE

Do not engage the autopilot with electric trim inoperable.

SECONDARY FLIGHT CONTROLS

The secondary flight controls consist of wing flaps and speedbrakes; both are electrically controlled and hydraulically actuated.

Two laminated, graphite composite Fowler type flaps on each wing can be positioned from zero to 35°. Mechanical interconnection of left- and right-wing flap segments prevents asymmetrical flap operation and permits flap operation with one hydraulic actuator.

The speedbrakes, consisting of slotted panels on top and bottom of the wing forward of the flaps, provide high descent rates and increased drag to aid braking during landing rollout.

FLAPS

The flap selector lever, detented at the 7° and 15° positions, can be set to position the flaps anywhere between zero and 35° (Figure 15-5). Lever movement actuates switches that energize a solenoid valve for flap operation. Flap position is shown on a pointer to the left of the

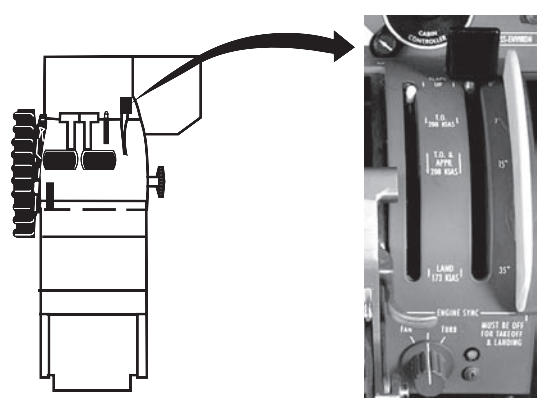


Figure 15-5. Flap Lever and Position Indicator

flap lever. The indicator is mechanically positioned by flap movement.

Operation

Moving the flap lever to any position causes the hydraulic system bypass valve to close for pressure buildup as indicated by illumination of the HYD PRESS ON annunciator. It also energizes the flap solenoid valve, directing pressure for flap operation (Figure 15-6).

When the flaps reach the selected position, the bypass valve opens to relieve hydraulic pressure, and the flap solenoid valve deenergizes to its neutral position. In the neutral position, the valve blocks all fluid lines to the actuators, hydraulically locking the flaps in that position.

In the event of electrical failure, the flap solenoid valve remains in the neutral position, and the flap position cannot be changed.

If hydraulic system failure occurs with the flaps retracted, they cannot be extended. With the flaps in an extended position, the flaps remain in the selected position unless the handle is moved. Once the solenoid valve is energized, the flaps may blow upward to a deflection as determined by the air loads present.

The elevator trim tabs are automatically, electrically repositioned to counter rapid pitch changes that occur during flap extension or retraction through the 15°–25° range.

The flap extension time from 0° to 35° is from 16 to 20 seconds. The retraction time from 35° to 0° is from 17 to 21 seconds.

SPEEDBRAKES

There are two speedbrake segments on the surface of each wing, one on the top and one on the bottom, which are operated by hydraulic actuators. The speedbrakes have two positions: extended and retracted. The system includes two hydraulic actuators, a control valve, four speedbrake segments, a safety valve, and a white SPEED BRAKE EXTEND annunciator. The system control switch and extended speedbrakes are shown in Figure 15-7.

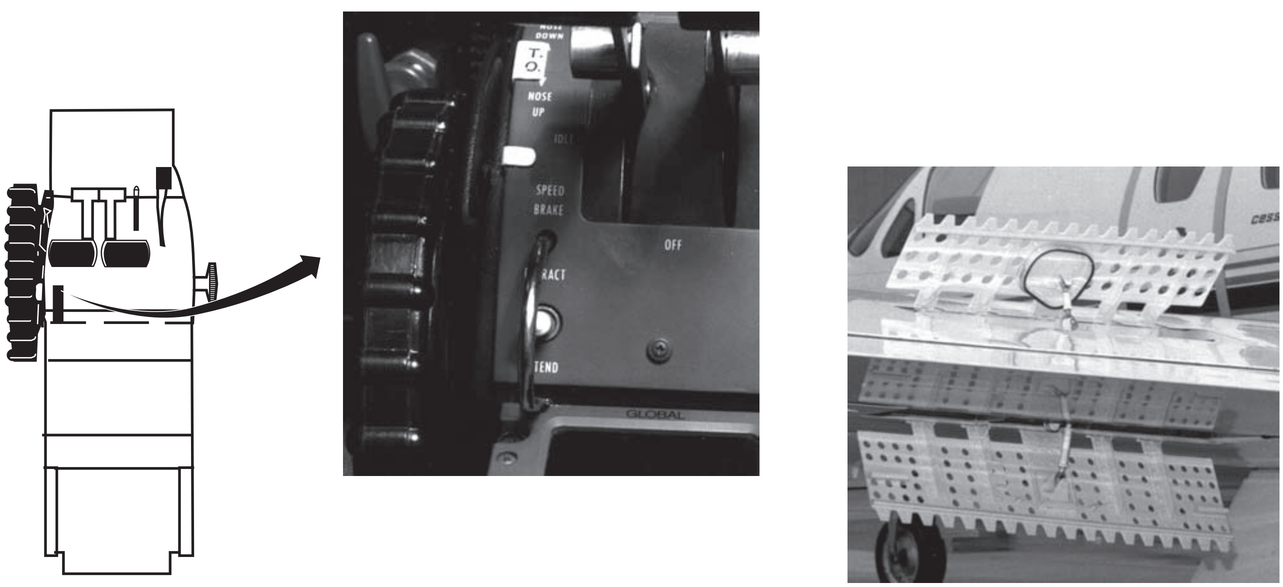


Figure 15-7. Speedbrake System

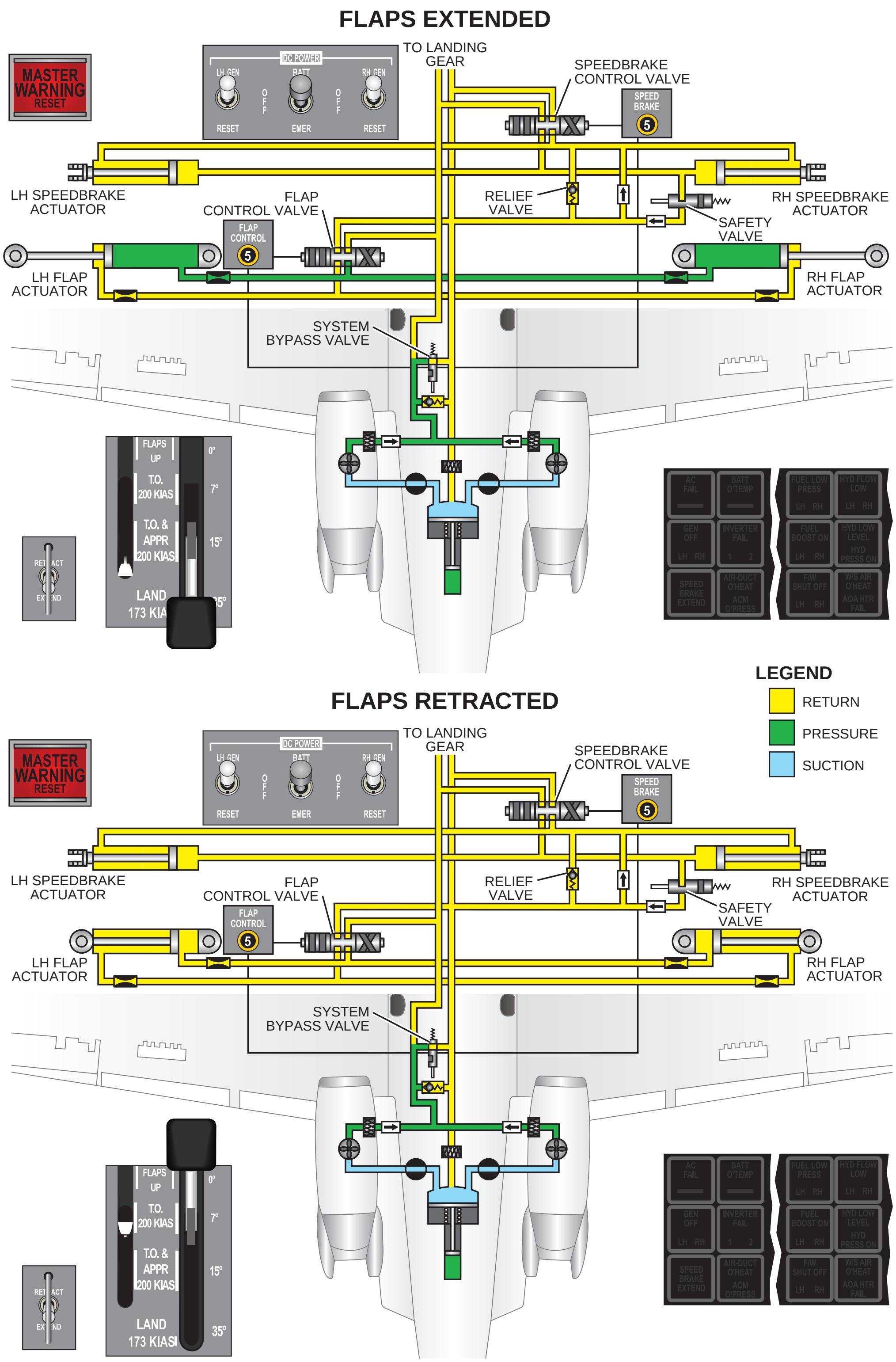


Figure 15-6. Flap Operation

Operation

Placing the speedbrake switch in the EXTEND position causes the hydraulic system bypass valve to close, providing pressure as indicated by illumination of the HYD PRESS ON annunciator. The speedbrake control valve is energized, directing pressure to force the speedbrakes out of their mechanical downlocks and extend them (Figure 15-8). The safety valve, in parallel with the control valve, is also energized closed.

With the speedbrakes on both wings fully extended, the white SPEED BRAKE EXTEND annunciator illuminates. Simultaneously, the hydraulic system bypass valve opens to relieve pressure, and the amber HYD PRESS ON annunciator goes out. The solenoid valve returns to neutral, blocking all fluid lines to the actuator, thus hydraulically locking the speedbrakes in the extended position.

To retract the speedbrakes, place the switch in the RETRACT position. The hydraulic system again pressurizes, the safety valve is deenergized and moves to the open position, and the speedbrake control valve is positioned to direct pressure for retraction (Figure 15-9). The SPEED BRAKE EXTEND annunciator goes out, the speedbrakes retract into mechanical locks, and the hydraulic system depressurizes. The mechanical locks consist of two pins on the lower speedbrake panel hydraulically forced into retaining clips in the lower wing.

If either throttle is advanced past 85% N_2 with speedbrakes extended, circuitry is completed

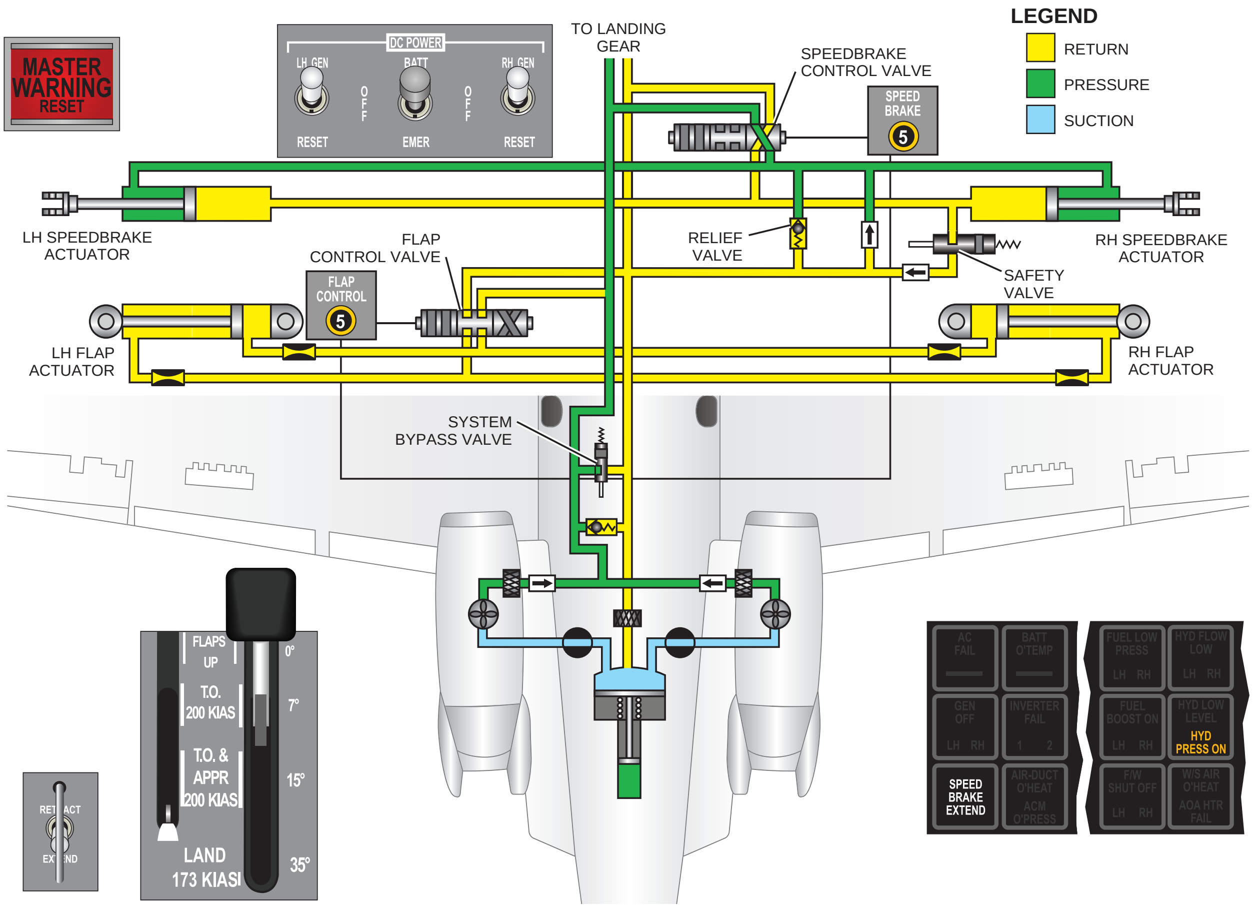


Figure 15-9. Speedbrake Retraction

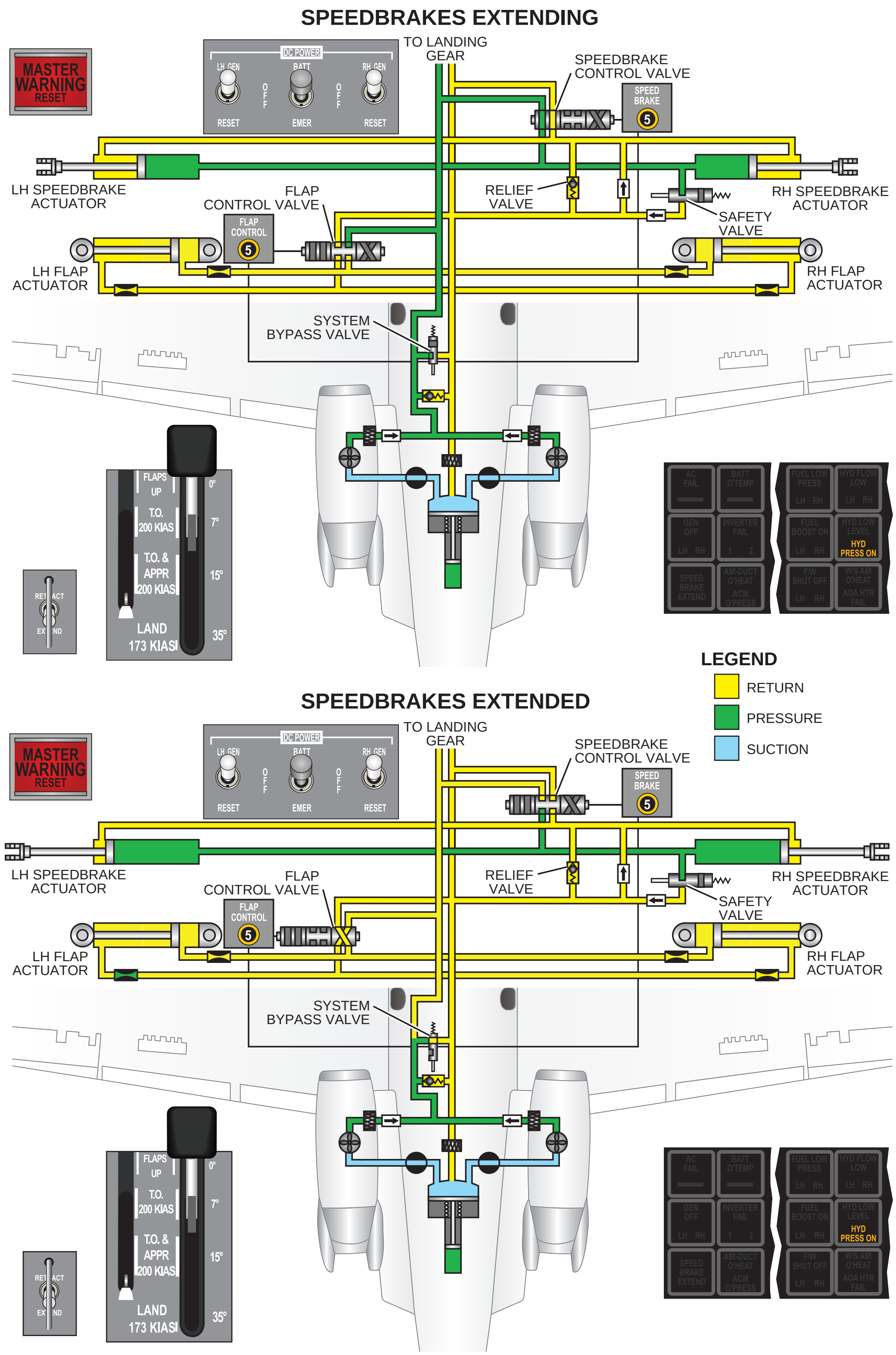


Figure 15-8. Speedbrake Extension

to the solenoid and bypass valve for speedbrake retraction.

If electrical failure occurs with the speedbrakes extended, the safety valve (Figure 15-10) spring loads open, allowing the speedbrakes to blow down. If electrical failure occurs with the speedbrakes retracted, they cannot be extended.

STALL WARNING

Stall warning consists of stall strips on the leading edge of each wing, and a stick shaker operated by the angle-of-attack system.

The stall strips create turbulent airflow at high angles of attack, causing a buffet to warn of approaching stall conditions (Figure 15-11).

An ANGLE OF ATTACK indicator on the pilot instrument panel, actuated by signals from the angle-of-attack probe on the right forward side of the fuselage, provides visual indication of aircraft angle of attack. The indicator can be used as a secondary reference for approach speed (1.3 VS1) at all aircraft weights and CGs at flap positions of zero, takeoff/approach, and landing. The AOA is increased to standard stall speeds +5 Kts with the ENGINE ANTI-ICE switches ON. It does not replace the airspeed indicator primary instrument.

A stick shaker motor, attached to the control column, vibrates the column as stall conditions progress. The shaker motor is energized by the

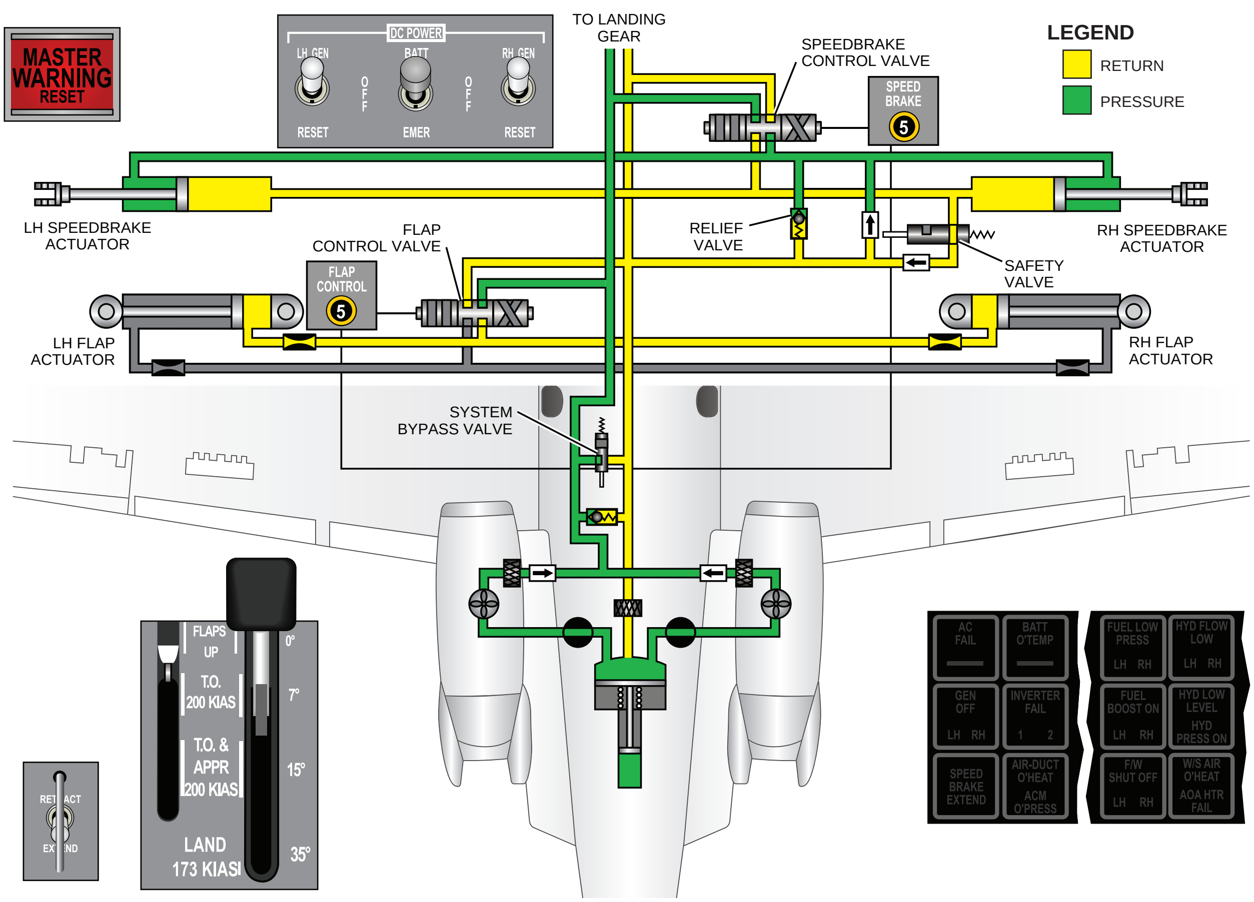


Figure 15-10. Speedbrake Blowdown (Electrical Failure)

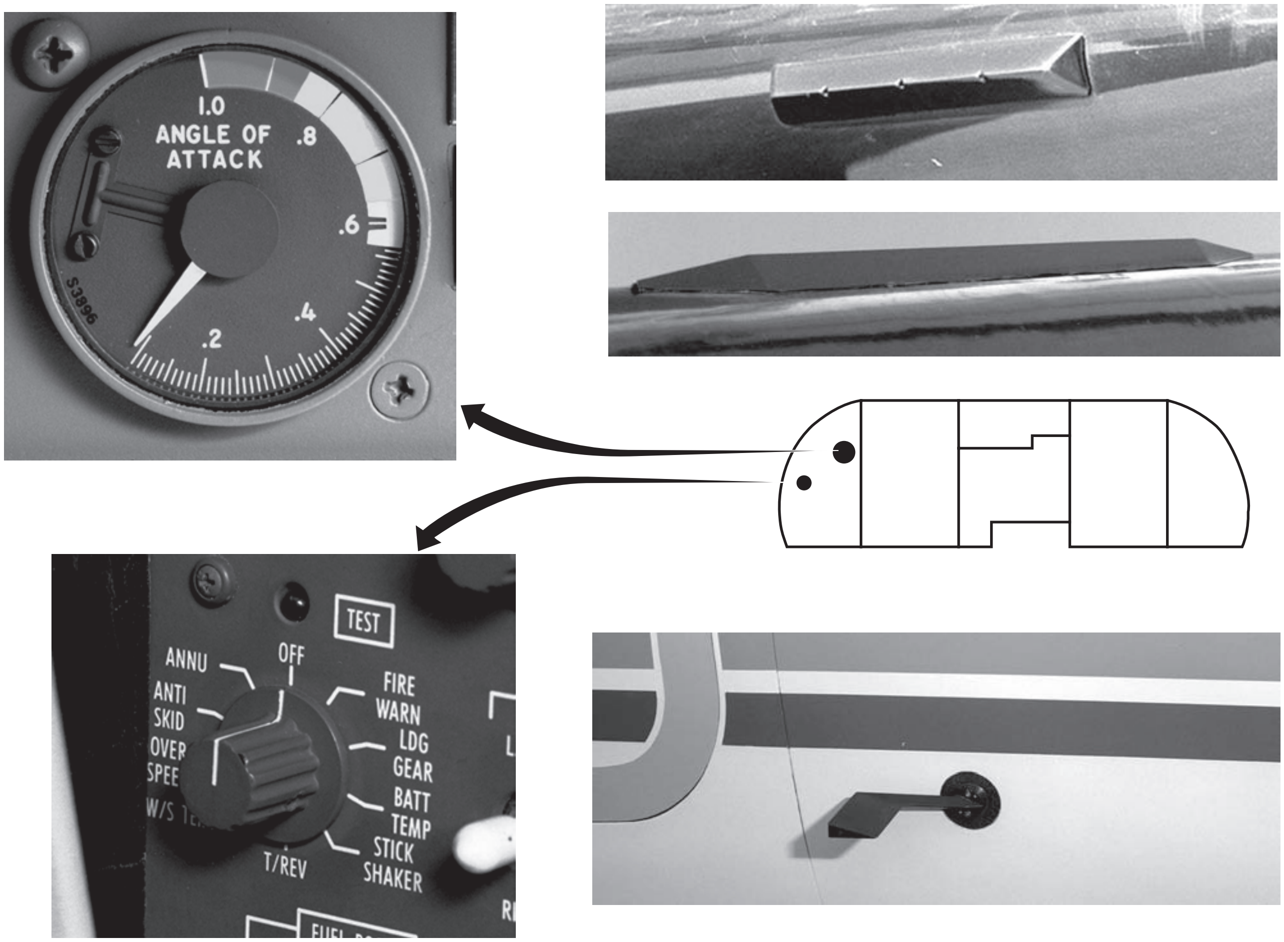


Figure 15-11. Stall Warning System

angle-of-attack system. At an ANGLE OF ATTACK indication of approximately 0.81 to 0.84 (conical probe) or 0.79 to 0.88 (vane probe), depending on flap setting and rate of deceleration, the shaker actuates.

Stick shaker circuitry is routed through landing gear squat switches which disable the shaker when the aircraft is on the ground. Test the system prior to flight by positioning the rotary TEST switch to STICK SHAKER. This bypasses the squat switch and applies a high angle-of-attack signal, causing the shaker motor to operate. If the stick shaker is inoperative, the aircraft must not be flown, except when the aircraft is operated in accordance with an approved MEL.

YAW DAMPING

Yaw damping is a function of the autopilot, consisting of automatic application of rudder against transient motion in the yaw axis. With the autopilot engaged, the yaw damper is engaged automatically. The yaw damper only can be engaged by depressing the YD ENGAGE switch on the autopilot control panel (Figure 15-12). An operative yaw damper is not required for flight.

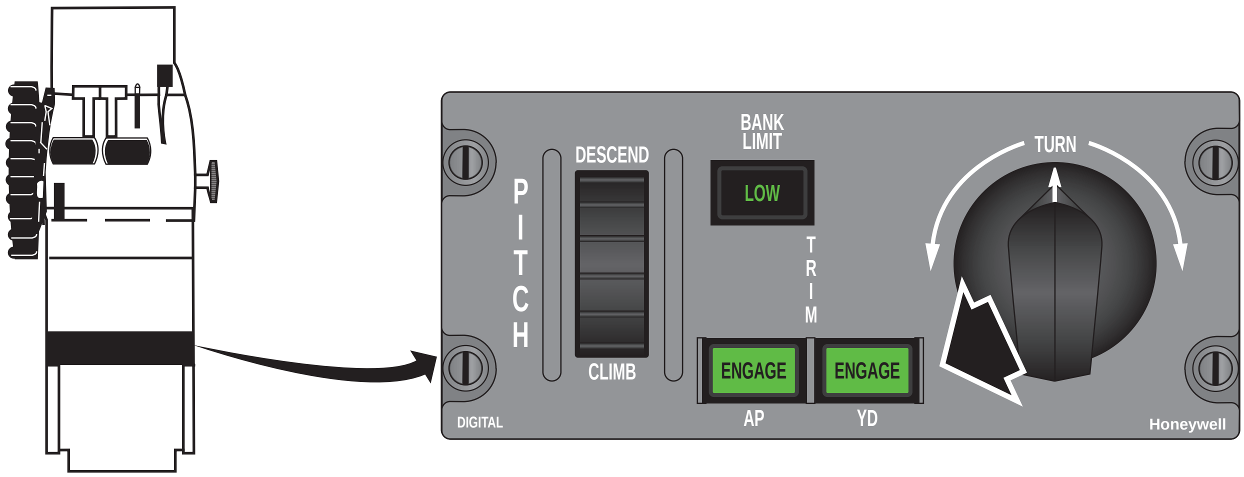


Figure 15-12. Yaw Damper Switch

QUESTIONS

1. The ailerons are operated by:

A. Hydraulic pressure.
B. Mechanical inputs from the control wheels.
C. A fly-by-wire system.
D. An active control system that totally eliminates adverse yaw.

2. The aileron trim tab is operated by:

A. An electrically operated trim tab motor.
B. A hydraulically operated trim tab motor.
C. A mechanical trim knob on the throttle control quadrant.
D. Changing the angle of the aileron fence.

3. Regarding the rudder:

A. The pilot and copilot pedals are interconnected.
B. The trim tab actuator is powered only electrically.
C. The servo is connected to the air data computer to restrict rudder pedal deflection at high airspeeds.
D. It is independent of the nosewheel steering on the ground.

4. The elevator:

A. Trim tab is controlled only electrically.
B. Runaway trim condition can be alleviated by depressing the AP/TRIM DISC switch and pulling the PITCH TRIM circuit breaker.
C. Electric pitch trim has both high speed and low speed positions.
D. Trim tab is on the right elevator only.

5. If hydraulic power is lost:

A. The flaps are inoperative.
B. The flaps operate with the backup electrical system, but extend and retract at a reduced rate.
C. There is no effect on wing flap operation.
D. A split flap condition could result if the flaps are lowered.

6. The wing flaps:

A. Can be preselected to only four positions (up, 7°, 15°, full).
B. Depend on both actuators to function to prevent a split flap condition.
C. Can be lowered manually if electrical power is lost, but only if all hydraulic fluid has not been lost.
D. Normally take 16 to 20 seconds to fully extend from the up position.

7. Regarding the gust lock:

A. The engines may be started with it engaged.
B. The aircraft should not be towed with it engaged.
C. It may be engaged for towing.
D. If the aircraft is towed past the 60° limit, nosewheel steering may be lost. It is still permissible to fly the aircraft if the gear is left down.

8. Moving the flap selector lever to any position:

A. Energizes the hydraulic system bypass valve closed.
B. Energizes the flap solenoid valve to the selected position.
C. A and B.
D. Energizes the electric hydraulic pump for flap operation.

9. If hydraulic failure occurs with the flaps extended, the flaps:

A. Blows upward immediately, depending on airload.
B. Cannot be fully retracted.
C. Can be retracted to the midrange position.
D. Can be completely retracted.

10. Extended speedbrakes are maintained in that position by:

A. Hydraulic pressure.
B. Trapped fluid in the lines from the solenoid valve.
C. Internal locks in the actuators.
D. External locks on the actuators.

11. The amber HYD PRESS ON light on the annunciator panel illuminates during speed brake operation:

A. When the speedbrakes are fully extended.
B. While the speedbrakes are extending and retracting.
C. Both A and B.
D. Neither A nor B.

12. A true statement concerning the speed brakes is:

A. The white SPEED BRAKE EXTEND annunciator illuminates whenever both sets of speedbrakes are fully extended.
B. If DC electrical failure occurs while the speedbrakes are extended, they remain extended since the hydraulic pressure is trapped on the extend side of the actuators.
C. If hydraulic pressure loss should occur while the speedbrakes are extended (system bypass valve fails open), the speed brakes automatically blow to trail.
D. The speedbrakes can only be retracted by placing the speedbrake switch to RETRACT.

CHAPTER 16
AVIONICS

CONTENTS

ILLUSTRATIONS

TABLES

CHAPTER 16 AVIONICS

INTRODUCTION

The Citation V Ultra aircraft avionics covered in this chapter includes a Primus® 1000 display and flight guidance system, emergency flight instruments, communication/navigation, pulse equipment, long-range navigation, pitot-static systems, and static discharge wicks. Avionics limitations are listed in the "Limitations and Specifications" section in the back of this manual. Many optional avionics items are available. The user should consult the applicable supplements in the *Airplane Flight Manual (AFM)*, Section III of the *Airplane Operating Manual*, and vendor handbooks for detailed information on standard and optional avionics system installed.

PRIMUS® 1000 SYSTEM

The Primus® 1000 integrated avionics system (IAS) is an advanced integrated system that provides display, flight director guidance, autopilot, yaw damper, and trim functions. The system block diagram is shown in Figure 16-1.

Standard elements consist of the following:

- IC-600 integrated avionics computers (IACs)
- Flight guidance system (FGS)(Autopilot control, No. 1 IAC only)
- Electronic flight instrument system (EFIS)
- AZ-840 air data system:
  - Dual micro air data computers (MADCs)
- Attitude and heading reference system:
  - Dual C-14D directional gyros
  - Dual VG-14A vertical gyros
- Primus® 650 weather radar

Optional elements consist of the following:

- LSZ-850 lightning sensor
- Primus® 870 weather radar
- Primus® II radio system
- Traffic alert and collision avoidance system (TCAS)

The Primus® 1000 is an integrated fail-passive autopilot/flight director and display system with a full complement of horizontal and vertical flight guidance modes. These include all radio guidance modes, long-range navigation tracking, and air data vertical modes. Either pilot can couple their respective EFIS to the autopilot (No. 1 IAC must be operational).

The flight guidance function of the integrated avionics computer (IAC) provides digital processing of heading, navigation, and air data information to the electronic flight instrument displays (EFIS). The electronic flight instrument system displays consist of a dedicated primary flight display (PFD) for each pilot (Figure 16-2) and a single multifunction display (MFD) installed on the center instrument panel (Figure 16-3).

The IC-600 IAC is the focal point of information flow in the system. The two IACs are interconnected by a digital high-level data link control (HDLC) bus. This bus and other interconnects allow the flight guidance computers and symbol generators associated with each IAC to share, compare, and communicate large blocks of information.

The IACs convert aircraft sensor input data and information digitally to the pilot-selected formats for the attitude director indicator (ADI) and horizontal situation indicator (HSI) on the PFDs and data to the MFD. The IACs also process data required for the flight director command bars and steering information for the autopilot.

The IACs have a built-in multilevel test capability which includes an automatic power-up self-test and pilot-initiated testing. It also includes on-ground maintenance testing and fault storage. The majority of the system is powered by 28 VDC. The vertical gyros require 115 VAC, 400 Hz and the directional gyro flux valve and rate gyro require 26 VAC, 400 Hz.

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

The electronic flight instrument system (EFIS) is an integral part of the Primus® 1000 integrated avionics system. The heart of each pilot system is an IC-600 integrated avionics computer (IAC). Except for the presence of the autopilot computer in the No. 1 IAC, the IACs are identical and interchangeable. In the normal configuration, the No. 1 IAC drives the pilot PFD and the No. 2 IAC drives the copilot PFD. The No. 1 or No. 2 IAC drives the MFD; it is normally controlled from the No. 1 IAC. Wraparound failure (miscompares) are used for critical parameters such as pitch or

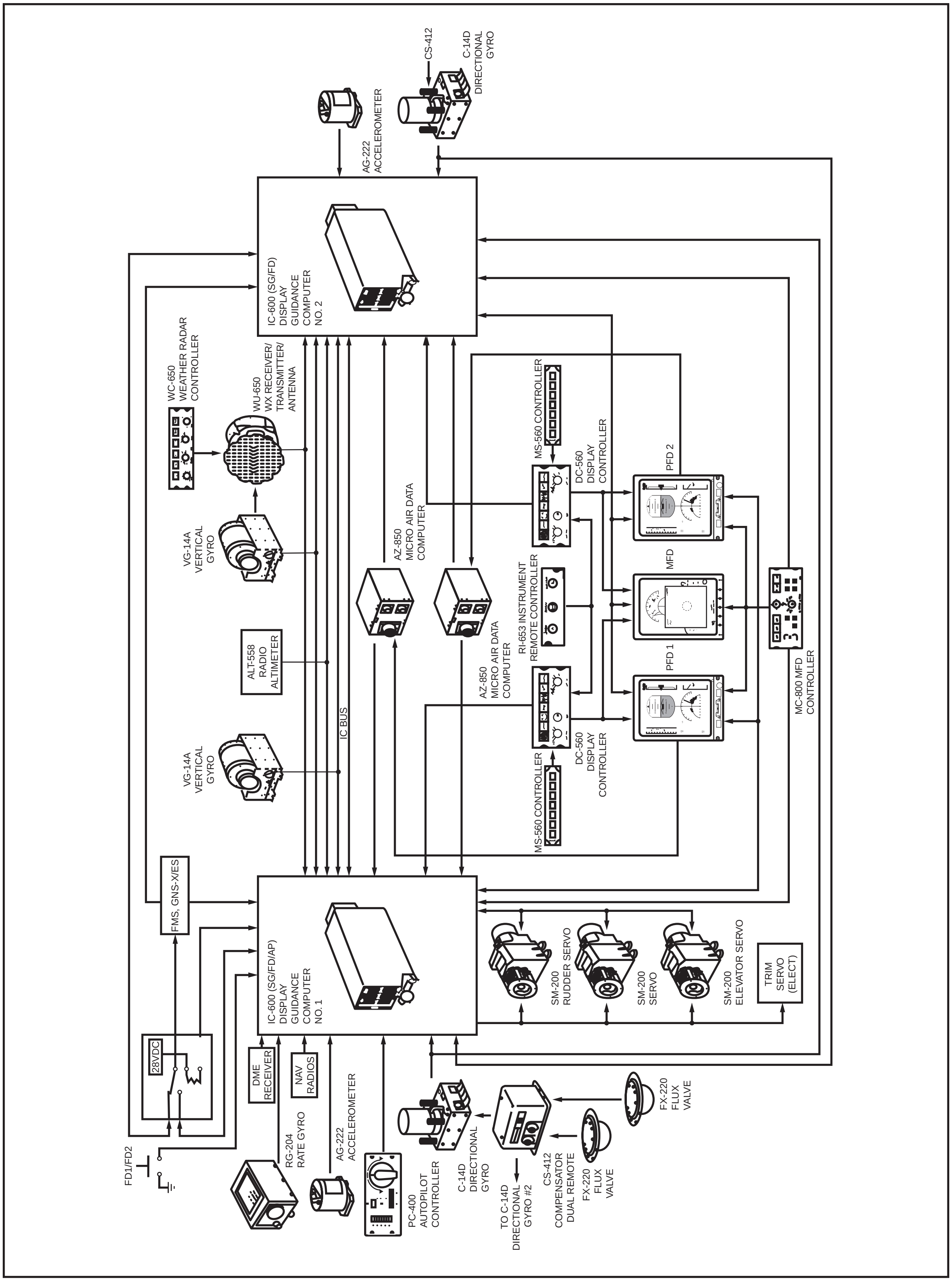


Figure 16-1. Primus® 1000 System Block Diagram

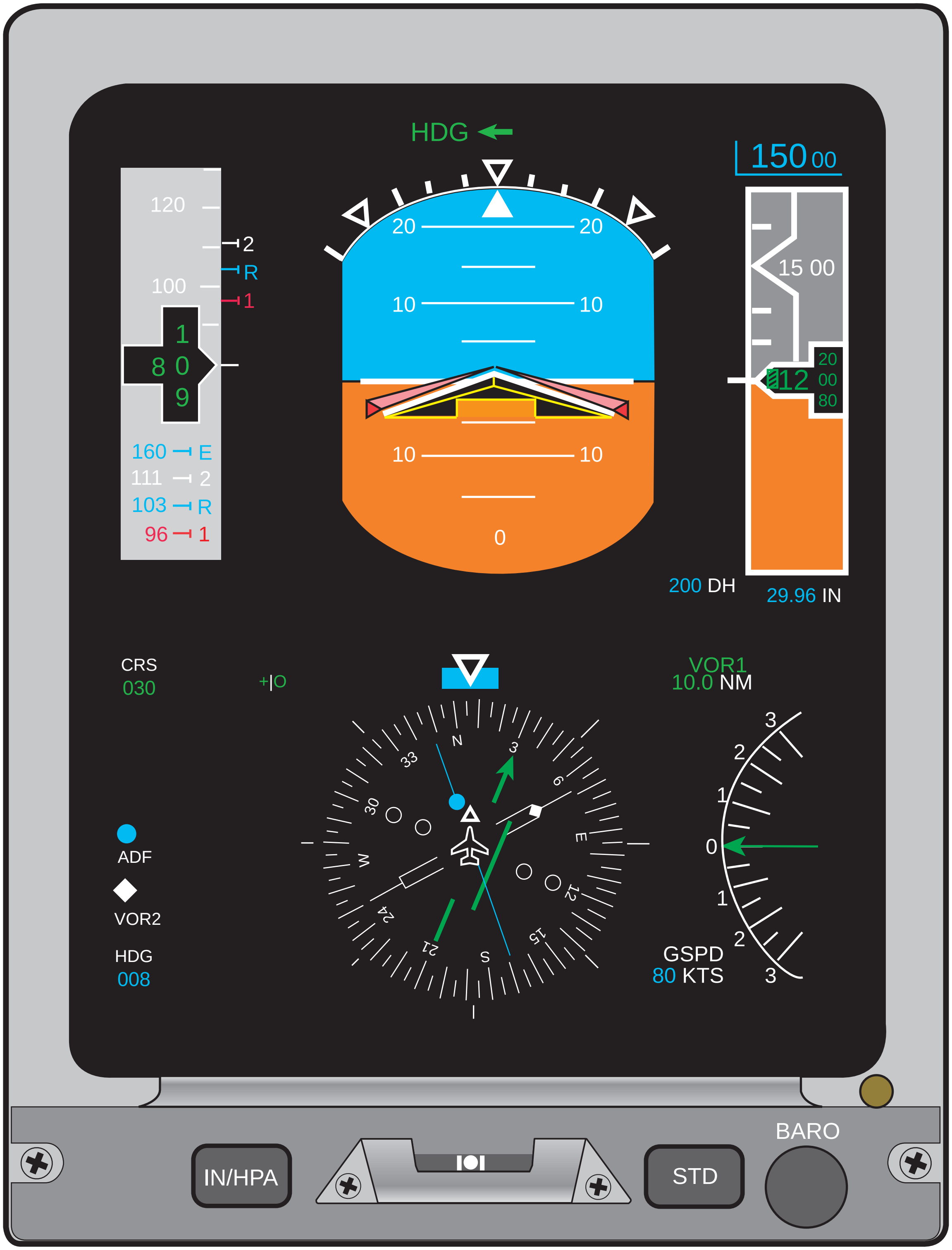


Figure 16-2. Primary Flight Display

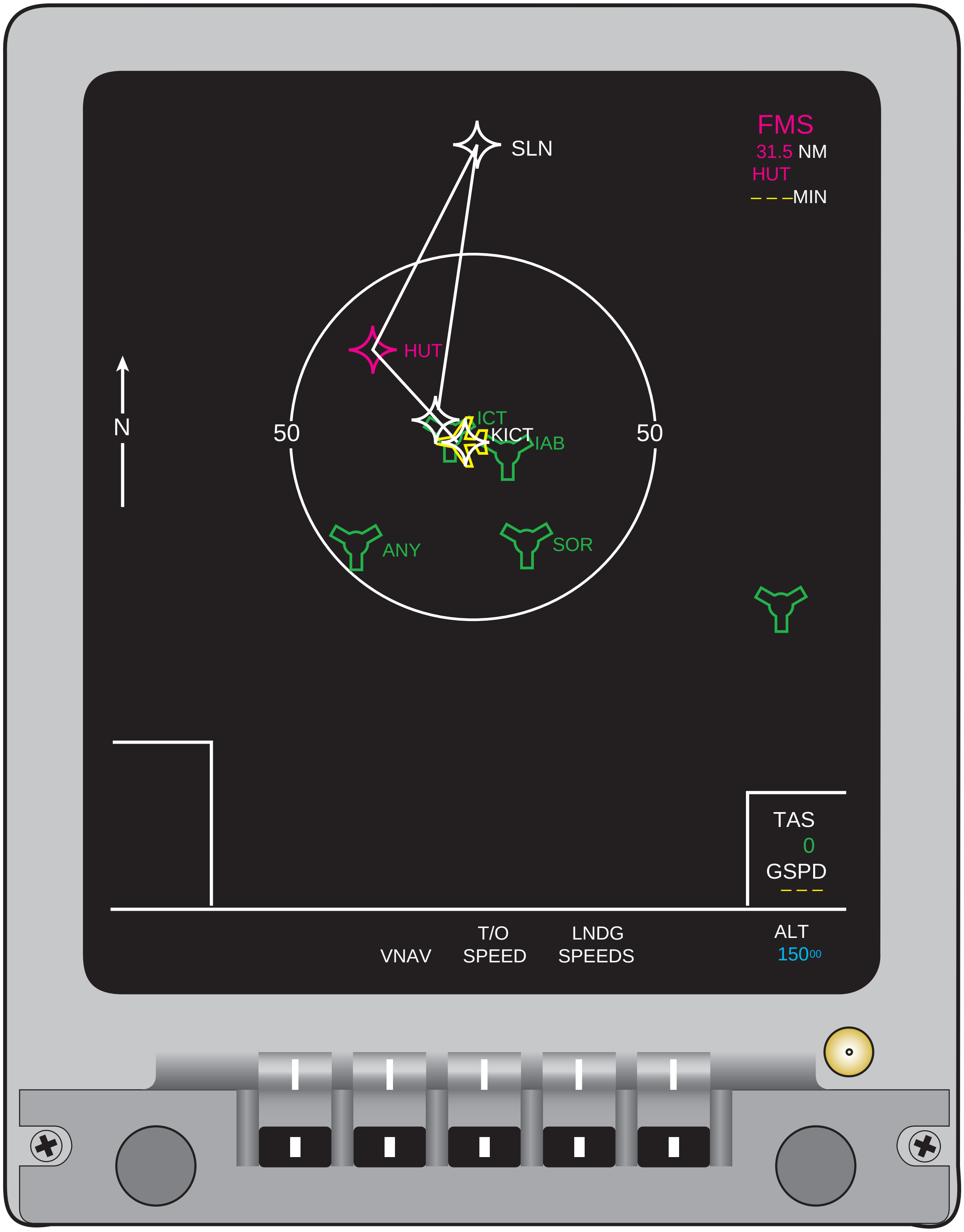


Figure 16-3. Multifunction Display (North UP—Plan View)

roll data, IAS, BARO set, to ensure information accuracy. The EFIS consists of the following elements:

- IC-600 integrated avionics computer (IAC) Included within each IAC are the following:
- Flight director computer
- Autopilot computer (No. 1 only)
- Symbol generator
- Sensor interfaces
- DU-870 display units (DUs),PFDs, and MFD
- BL-870 PFD bezel controllers (2)
- BL-871 MFD bezel controller
- DC-550 display controllers (2)
- RI-553 instrument remote controller
- MC-800 MFD controller

The EFIS displays, pitch and roll attitude, heading, course orientation, flight path commands, weather presentations, checklists, mode and source annunciators, air data parameters, long range navigation map displays and optional TCAS information.

EFIS brings display integration, flexibility, and redundancy to the flight control system. Essential flight information, automatic flight control, and navigation data are integrated into the pilot prime viewing area. Selection of essential flight data, including various navigation information, aircraft performance parameters, and weather radar displays, is accomplished by using the PFD display controllers, MFD controller, weather radar controller, and the display-unit-mounted bezel controllers. Each IAC symbol generator (SG) is capable of driving the three displays. The symbol generators function as data processors for processing aircraft sensor inputs to format correct information as defined by the display controllers to the display units (PFDs and MFD).

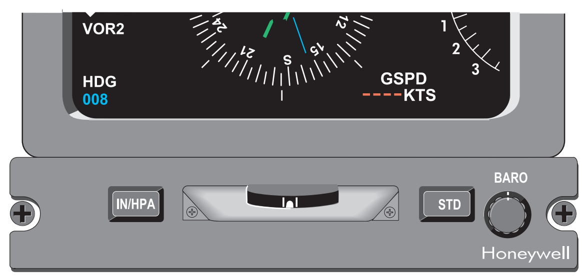
Reversion switches allow for substituting operational sensors for failed ones, i.e., vertical gyros, directional gyros, air data computers, symbol generators, and PFD reversion to MFD.

Controllers

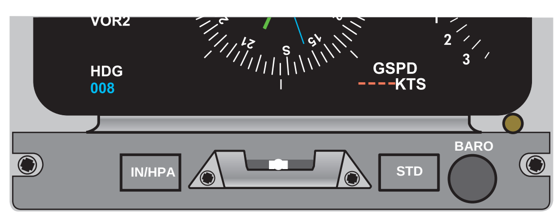
BL-870 PFD Bezel Controller

The PFD bezel controller is on the lower front of the PFD and provides the following functions (Figure 16-4):

- IN/HPA Pushbutton:
  - SNs 0001 through 0401—Selects the display of the altimeter barometric correction in inches of mercury (Hg) or hectopascals (HPa).
  - SNs 0401 and on—Has been removed from the lower front of the PFD and is now on the display controller.
- STD—Pushbutton returns the barometric altimeter correction to standard value (29.92 in. Hg or 1,013 HPa).
- BARO—Rotary set knob allows selection of reported barometric altimeter correction in either inches Hg or HPa as determined by the IN/HPA pushbutton.



SNs 0001 THROUGH 0400



SNs 0401 AND ON

Figure 16-4. PFD Bezel Controller

NOTE

When the pilots are displaying cross-side micro air data computer (amber MADC) data on their PFDs, only the operating side MADC PFD bezel has control over both BARO settings.

NOTE

The BARO set operates independently from the display controllers and does not require that the display controller be functional to set data.

BL-871 MFD Bezel Controller

The MFD bezel controller (Figure 16-5) allows access for setting takeoff V-speeds, landing V-speeds, and vertical navigation (VNAV) data through five menu-item pushbuttons and a rotary knob (left side) for setting data on various menus. The right rotary knob is used solely for altitude preselect inputs (displayed simultaneously on the MFD and both PFDs).

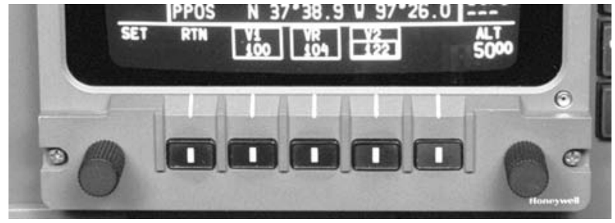


Figure 16-5. MFD Bezel Controller

MFD Menu Operation

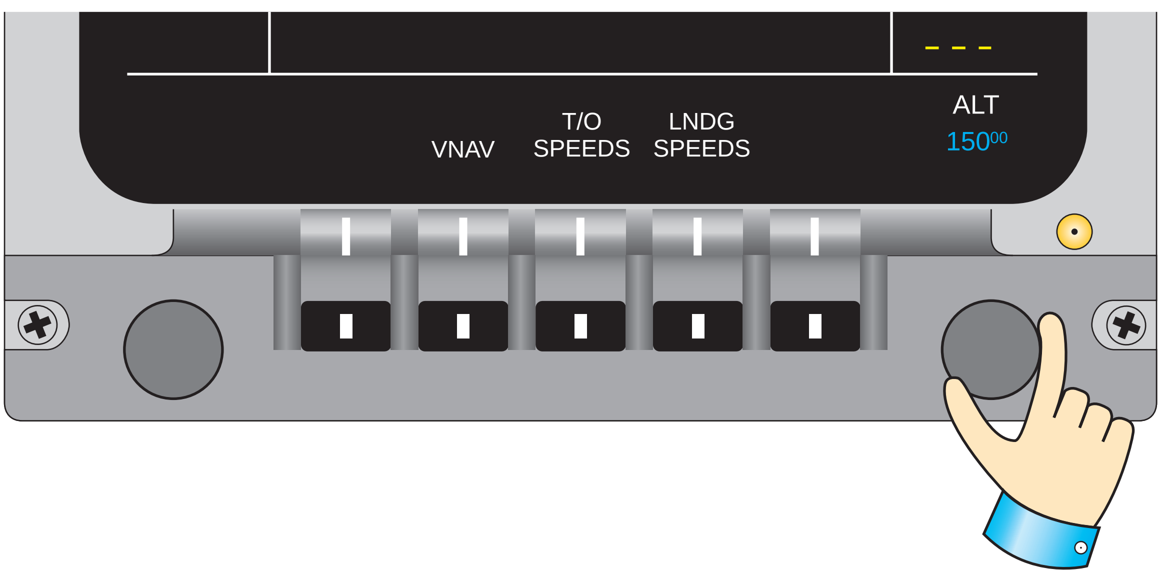
Figure 16-6 describes the basic MFD menu procedures.

T/O SPEEDS Menu Operation

Figure 16-7 describes the procedure used to set T/O SPEED parameters.

LNDG SPEEDS Menu Operation

Figure 16-8 describes the procedure used to set LNDG SPEEDS parameters.



The right rotary knob is used only for altitude preselect inputs (altitude preselect and VNAV functions). All menu pages of the MFD, display the digital readout of the selected altitude. The altitude preselect value is set in increments of 100 feet and can be changed at any time regardless of the status of any other set parameters.

Figure 16-6. Basic MFD Menu Operation (Sheet 1 of 3)

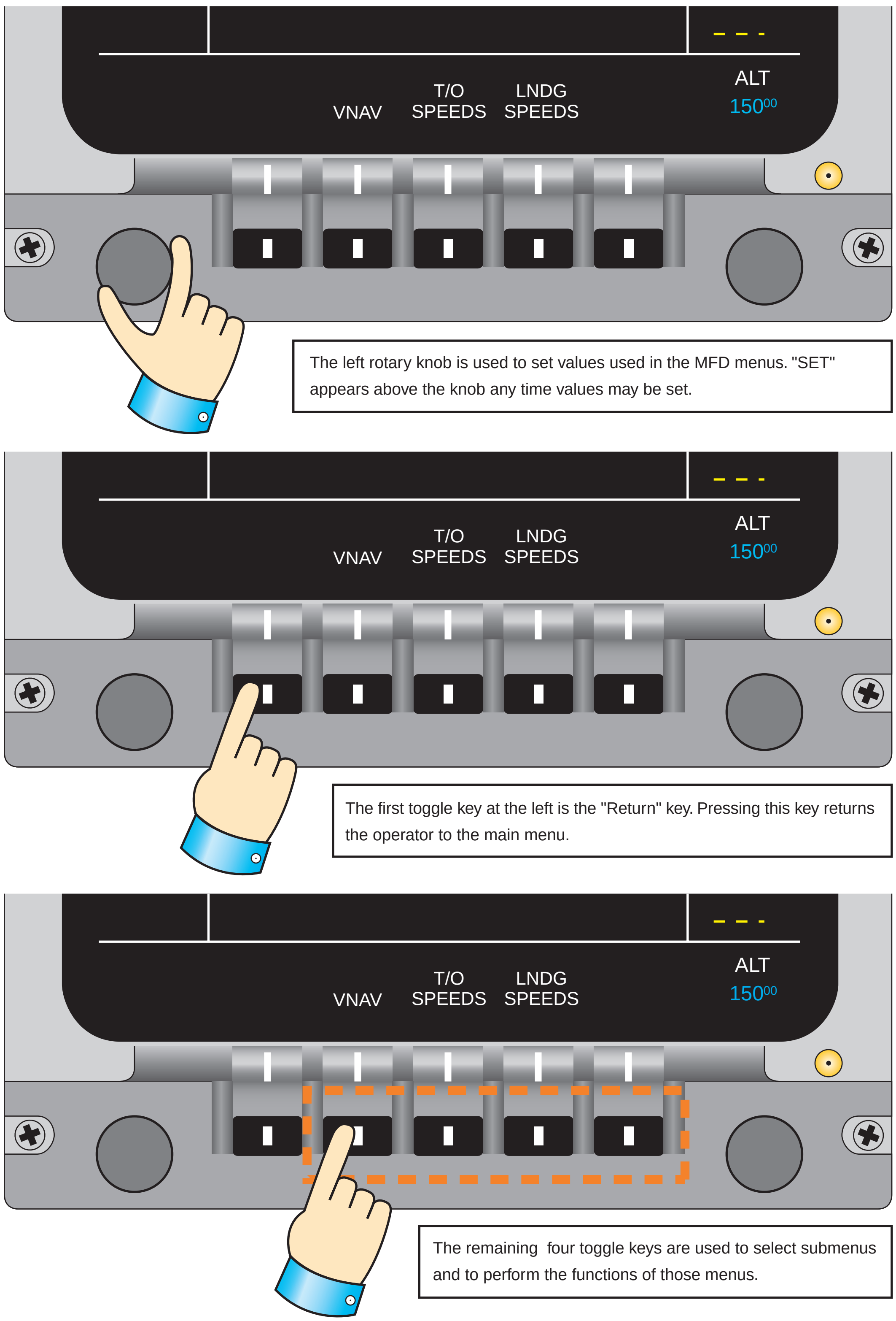


Figure 16-6. Basic MFD Menu Operation (Sheet 2 of 3)

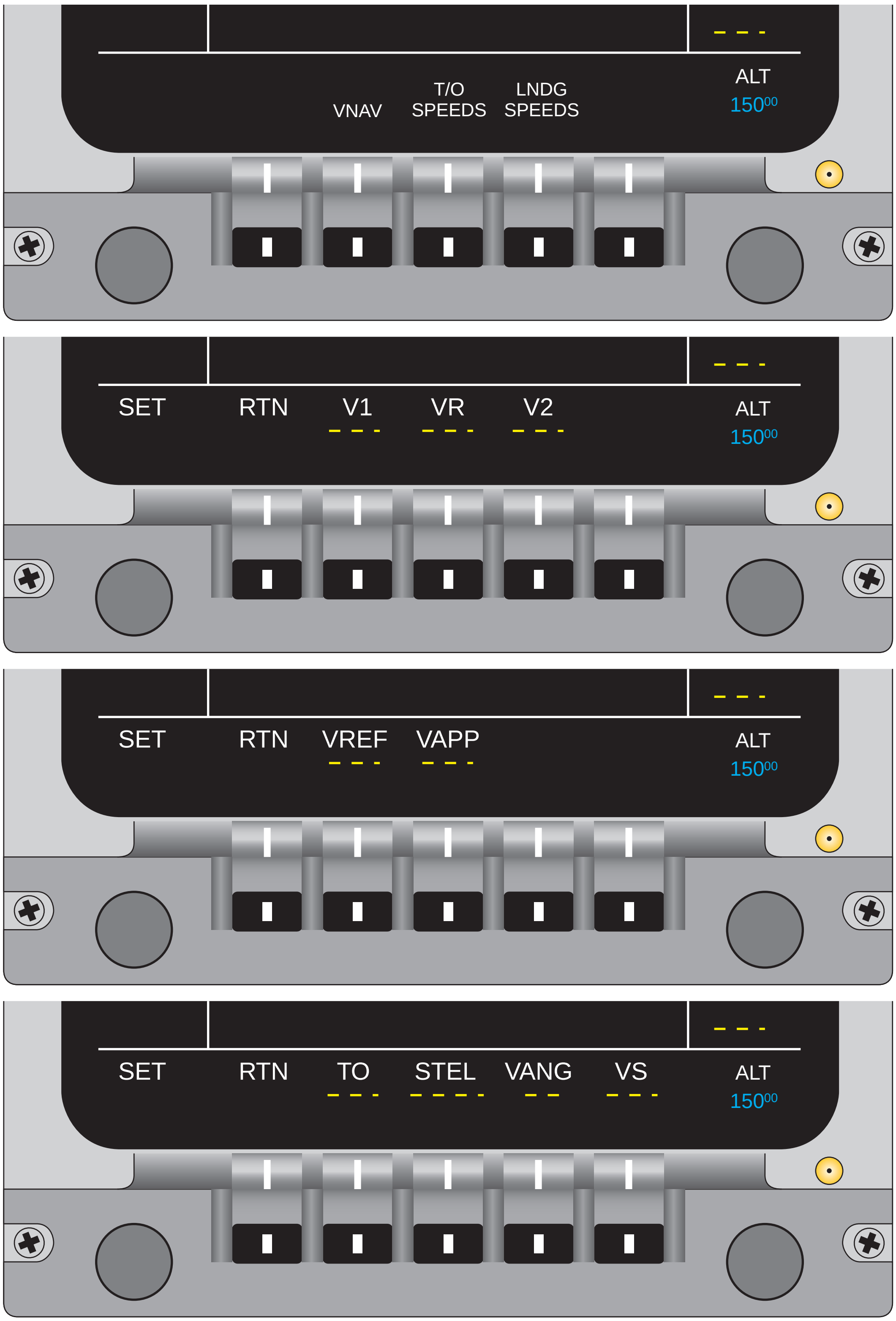


Figure 16-6. Basic MFD Menu Operation (Sheet 3 of 3)

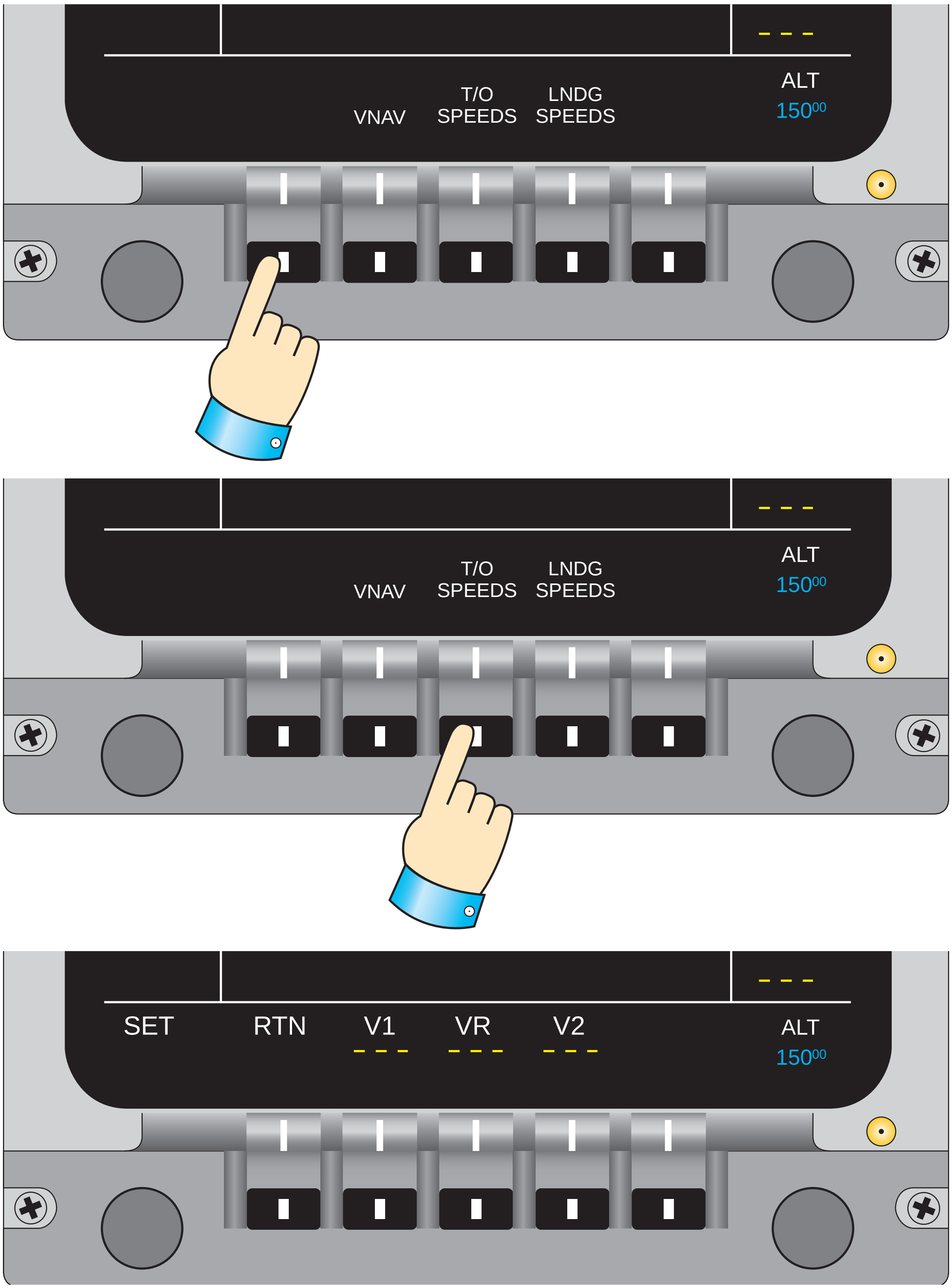


Figure 16-7. T/O SPEEDS Menu Operation (Sheet 1 of 4)

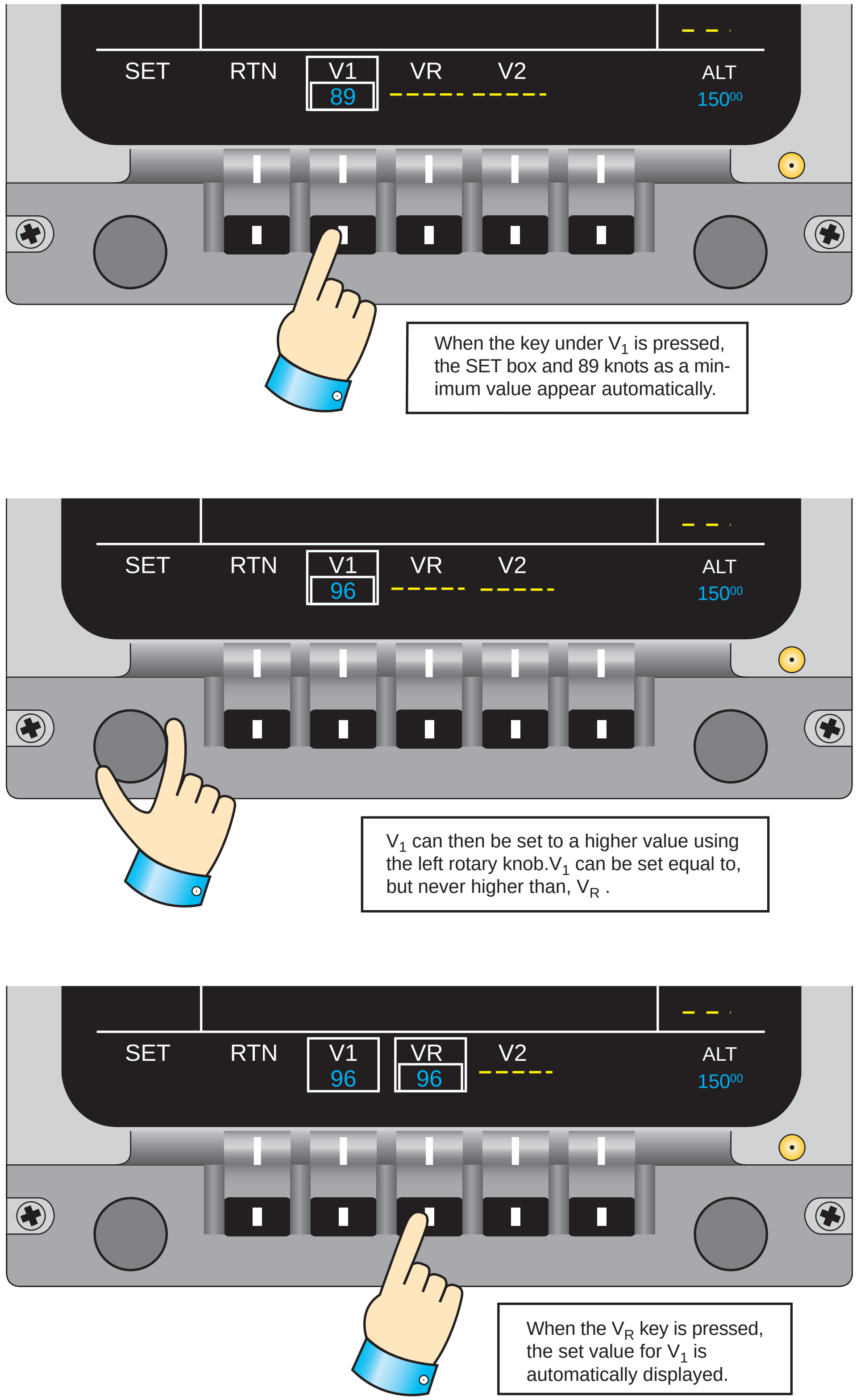


Figure 16-7. T/O SPEEDS Menu Operation (Sheet 2 of 4)

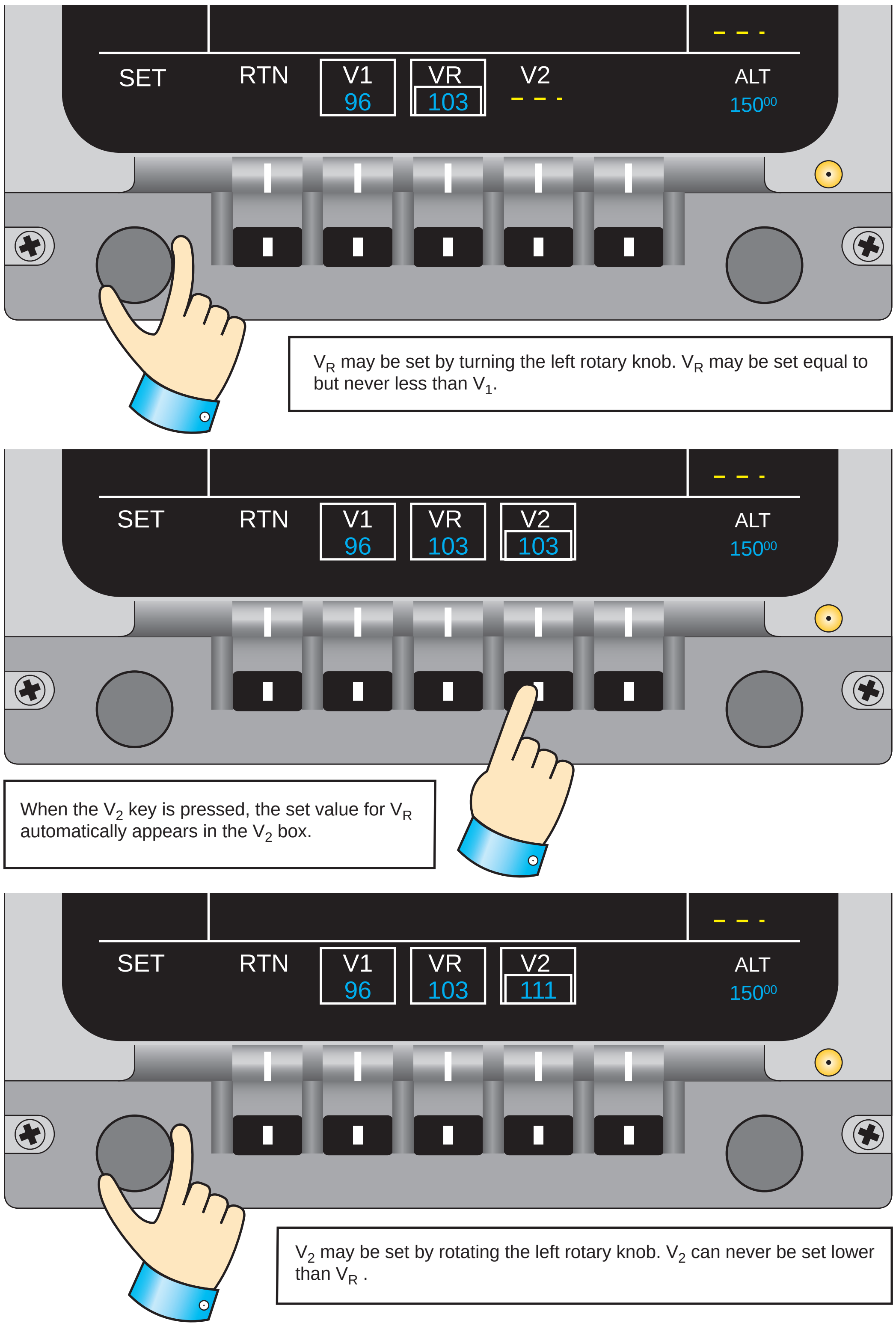


Figure 16-7. T/O SPEEDS Menu Operation (Sheet 3 of 4)

V_E is automatically set at 160 knots and will appear on the airspeed scale of the primary flight display (PFD) as soon as V_1 is set on the MFD.

Takeoff V-speeds displayed at the bottom of the vertical speed scale automatically cancel at liftoff and the tick marks are removed from the PFD airspeed scale including V_E when actual airspeed exceeds 230 KIAS.

When setting the takeoff V-speeds, the operator should not use the return key or the toggle key beneath the V-speed being defined. The only exception is the toggle key beneath V_2. This key needs to be pressed after the V_2 speed has been set in order to lock in the value for V_2. If the key is not pressed after the value has been set, any movement of the left rotary knob changes the V_2 value.

NOTE

> If a V-speed which has already been set is selected a second time, the speed digits and speed bug are removed from the airspeed scale on the PFD and the white box is removed on the MFD. The set digits continue to be displayed on the MFD.

When system power is turned on (power up), all V-speeds are cancelled, and values appear as dashes on the display.

Figure 16-7. T/O SPEEDS Menu Operation (Sheet 4 of 4)

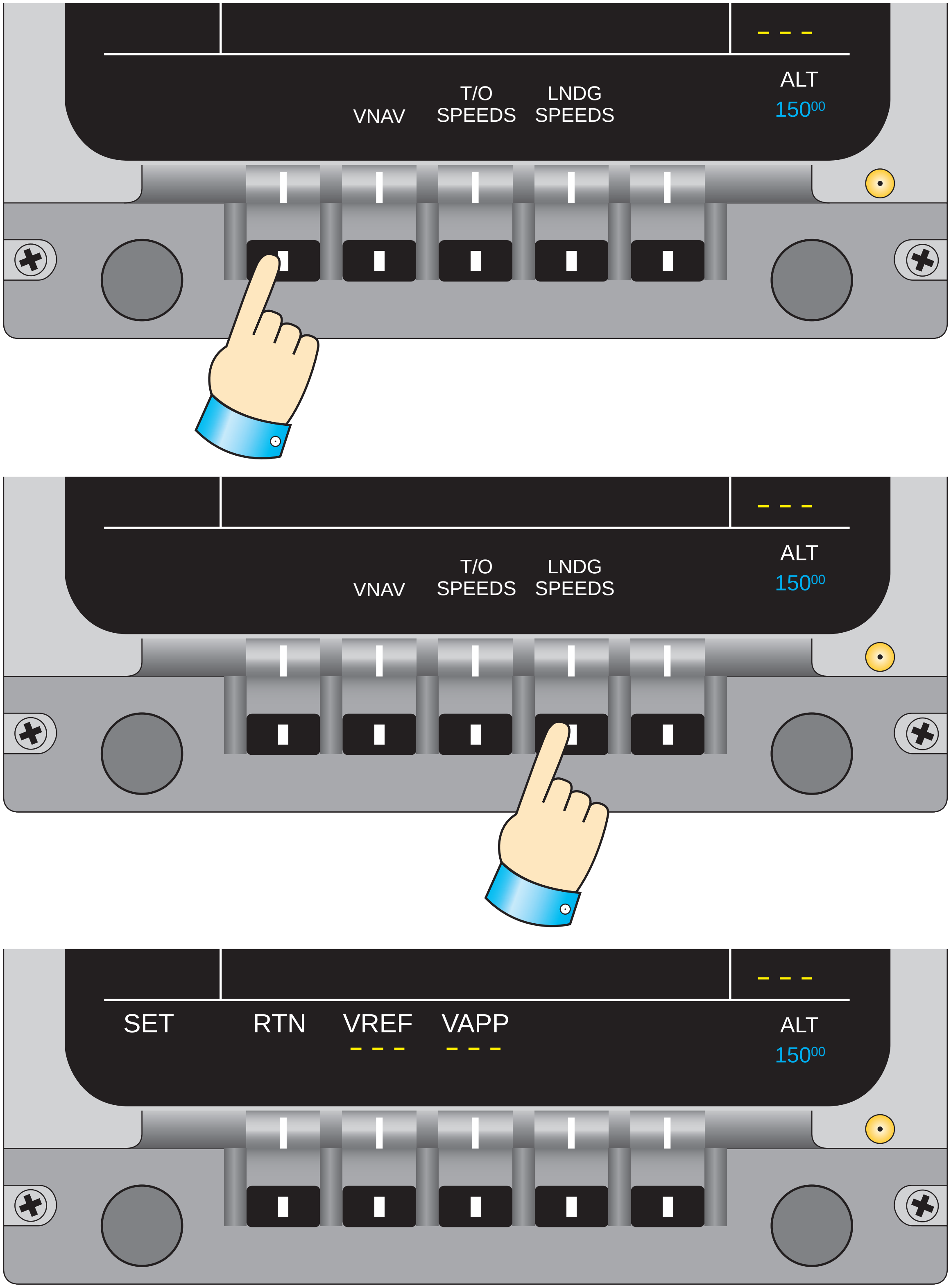


Figure 16-8. LNDG SPEEDS Menu Operation (Sheet 1 of 3)

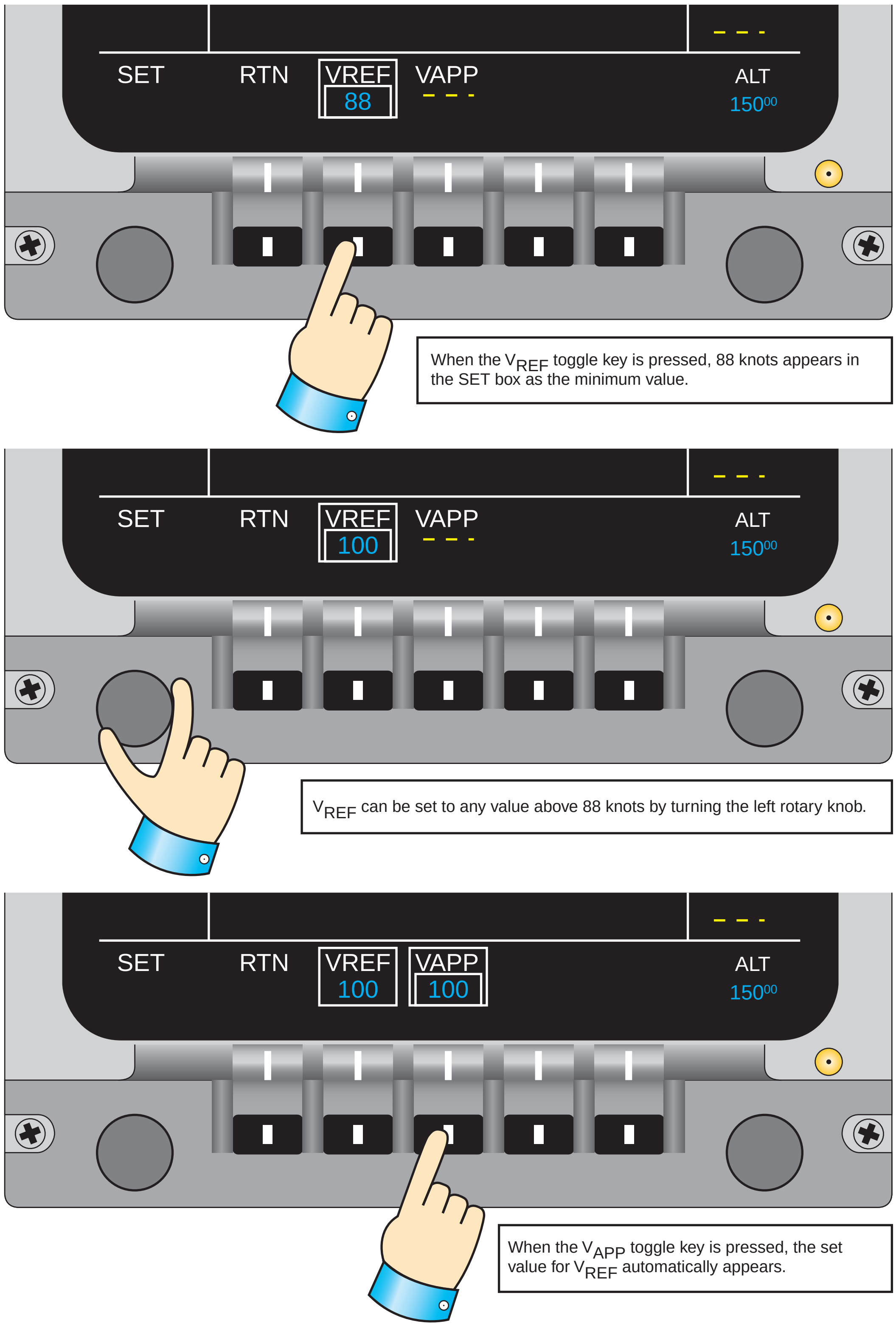
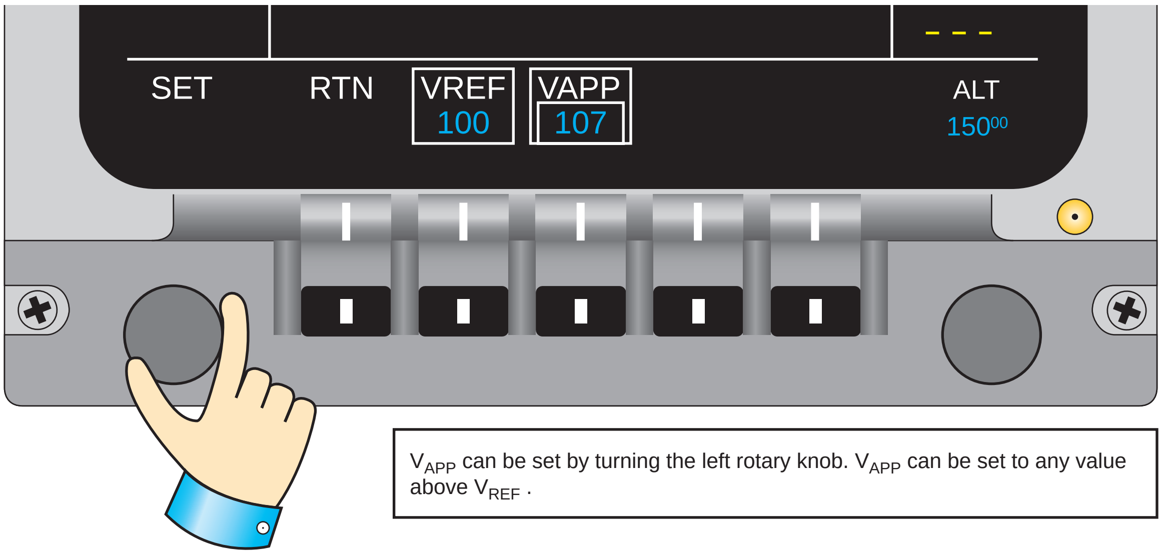


Figure 16-8. LNDG SPEEDS Menu Operation (Sheet 2 of 3)



Landing V-speeds remain displayed until power is removed from the system after landing.

When setting the landing V-speeds, the return key and the toggle key beneath the V-speed being defined should not be used.

NOTE: If a previously set V-speed is again selected, the speed bug is removed from the airspeed scale on the PFD, and the white box is removed from the MFD. The set digits remain on the MFD.

Figure 16-8. LNDG SPEEDS Menu Operation (Sheet 3 of 3)

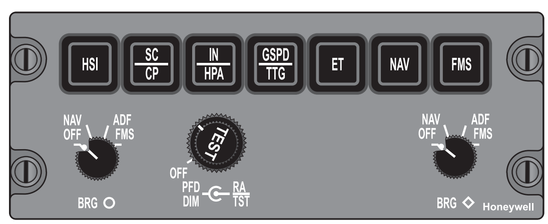
VNAV Menu Operation

Figure 16-9 describes the procedure used to set VNAV parameters.

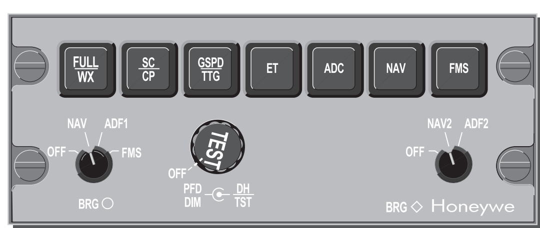
DC-550 Display Controller

The display controllers, directly to the left and right respectively of the pilot and copilot PFDs on the instrument panel, allow the pilots to select various formats on the PFDs (Figure 16-10). These functions are described below:

- ***FULL/WX Button:***
    - SNs 0001 through 0401—Controls full or WX (partial compass display). Displays 360° in FULL mode and 90° in WX (ARC) mode. Successive pushes change the mode back and forth. WX returns can be displayed on the PFD when in WX mode and radar is transmitting.
    - SNs 0401 and on—Has been renamed HSI.



SNs 0001 THROUGH 0400



SNs 0401 AND ON

Figure 16-10. Display Controllers

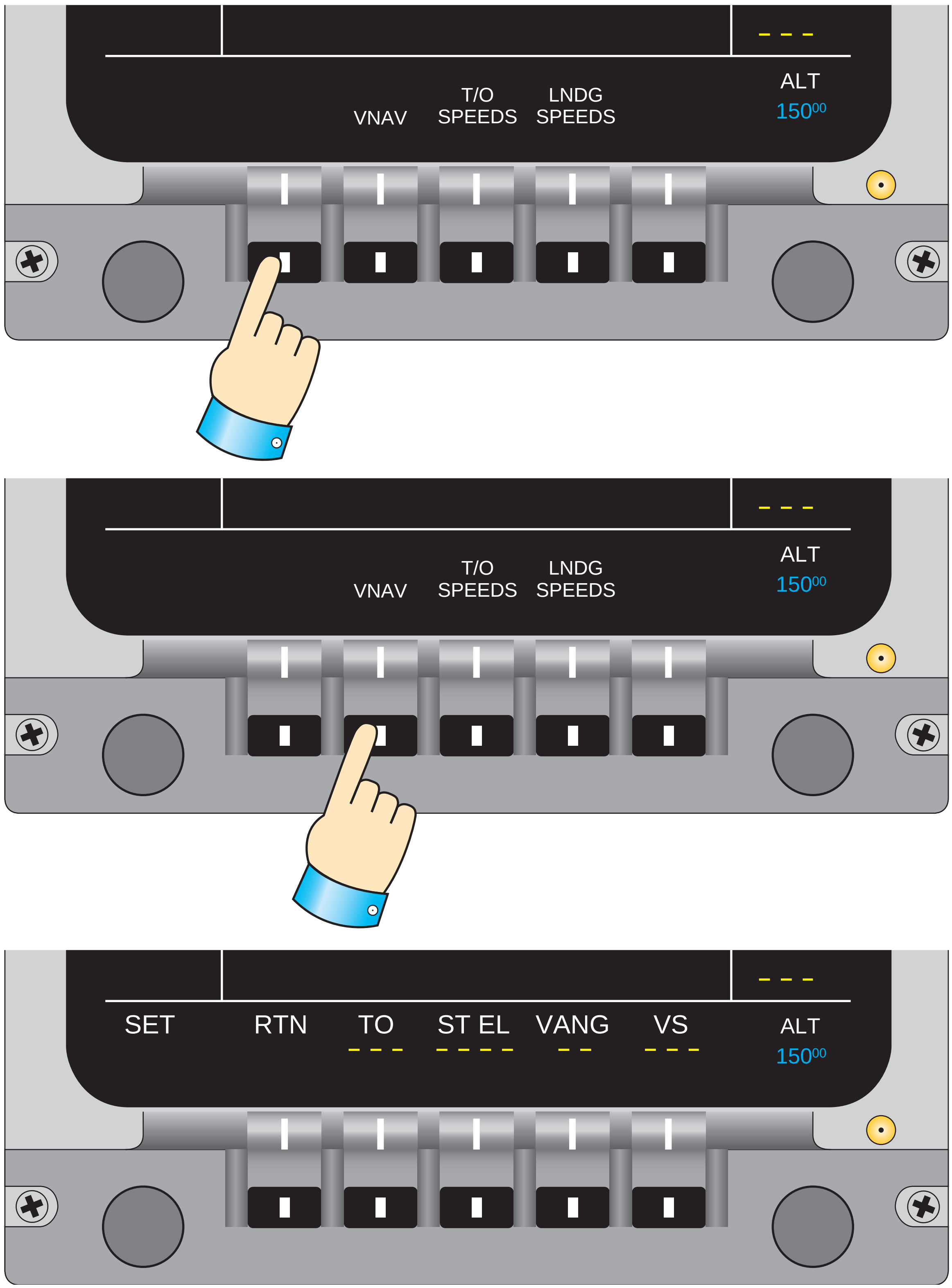


Figure 16-9. VNAV Menu Operation (Sheet 1 of 4)

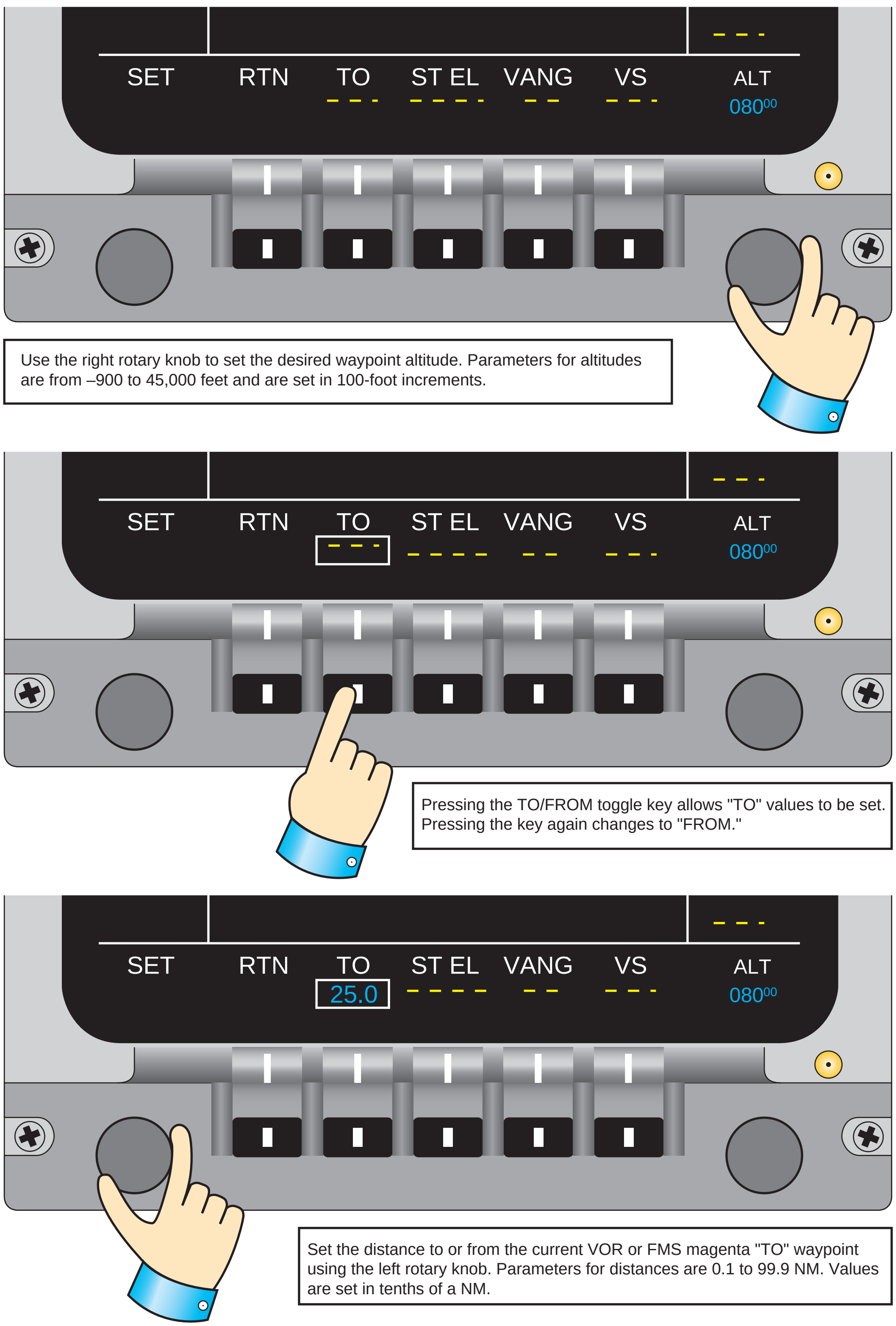


Figure 16-9. VNAV Menu Operation (Sheet 2 of 4)

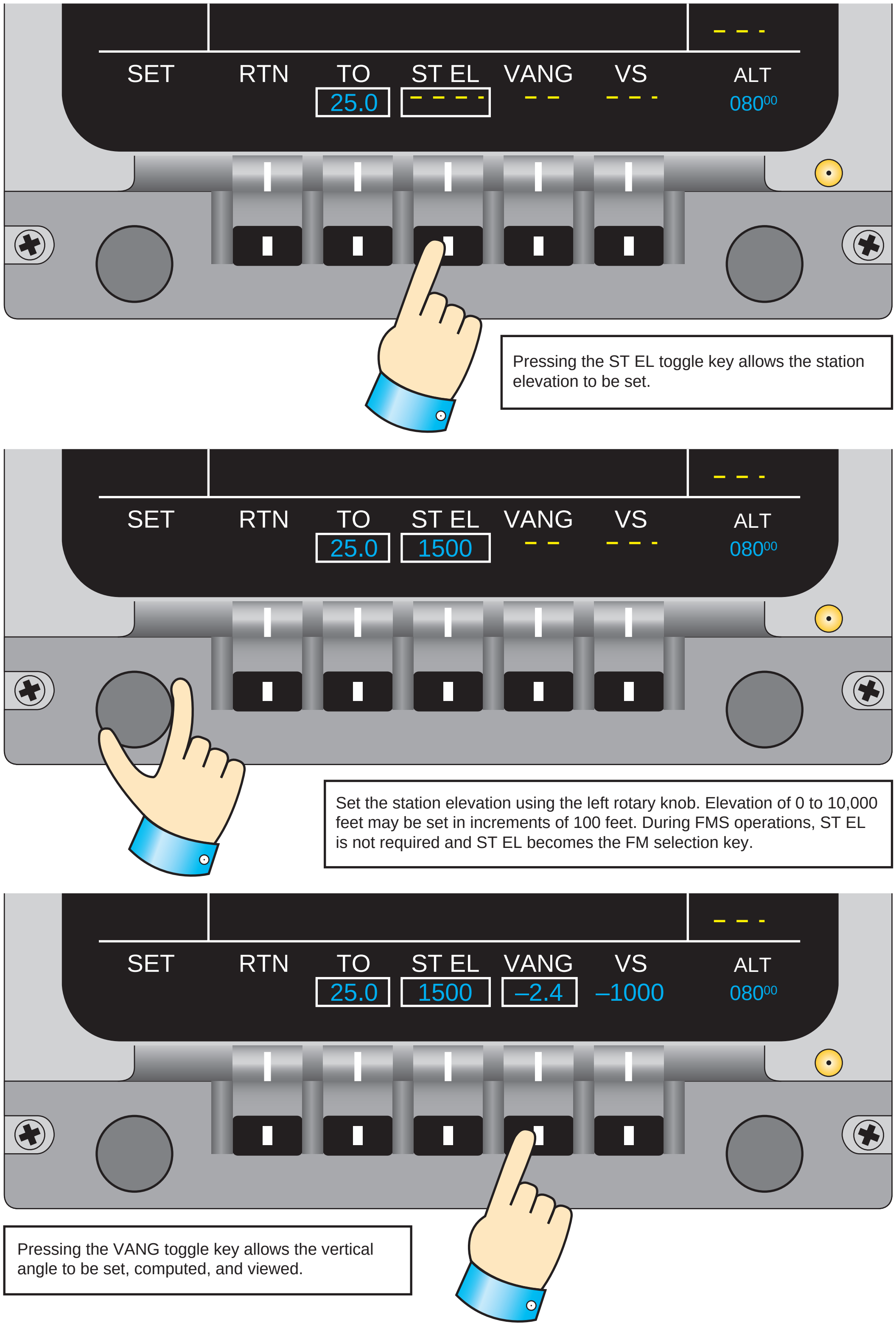
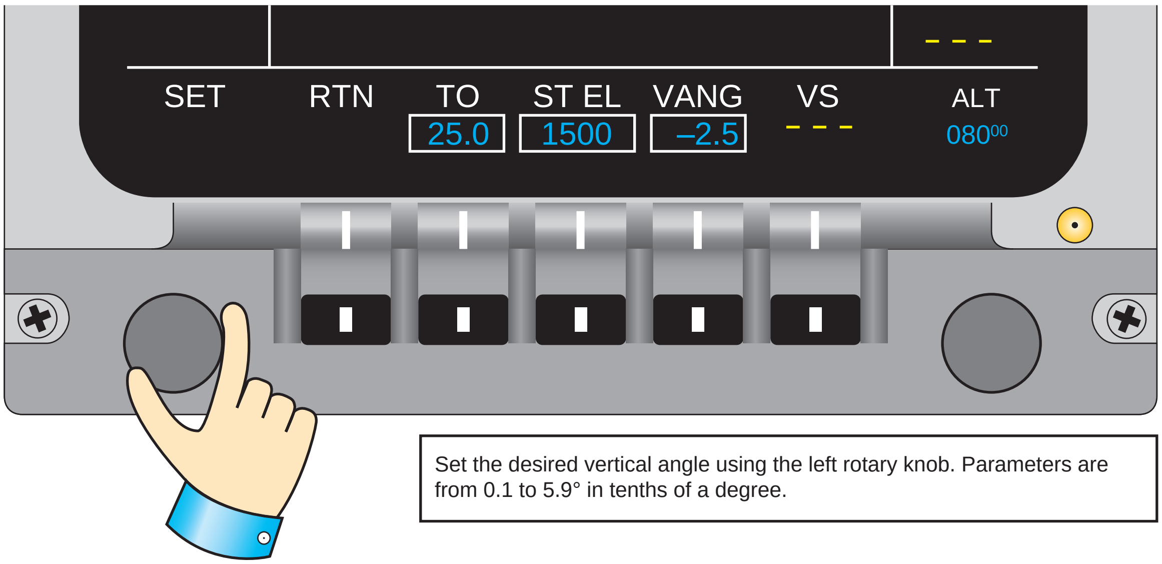
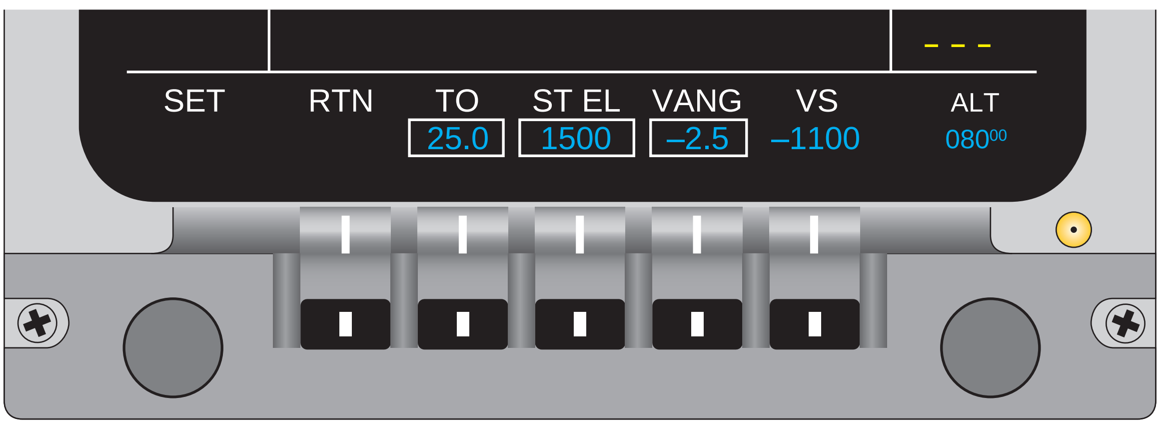


Figure 16-9. VNAV Menu Operation (Sheet 3 of 4)



Set the desired vertical angle using the left rotary knob. Parameters are from 0.1 to 5.9° in tenths of a degree.



The vertical speed is automatically calculated and displayed based on the data already entered. Vertical speed cannot be changed by the operator.

When using the VNAV menu as depicted in this sequence, the vertical angle is automatically computed and displayed. The operator may wish to choose a steeper angle than what is computed and can select a steeper angle by pressing the toggle key beneath VANG as depicted and setting the desired value. It is important to remember that a shallower angle than computed is not possible since the airplane is already past a point to initiate a shallower descent.

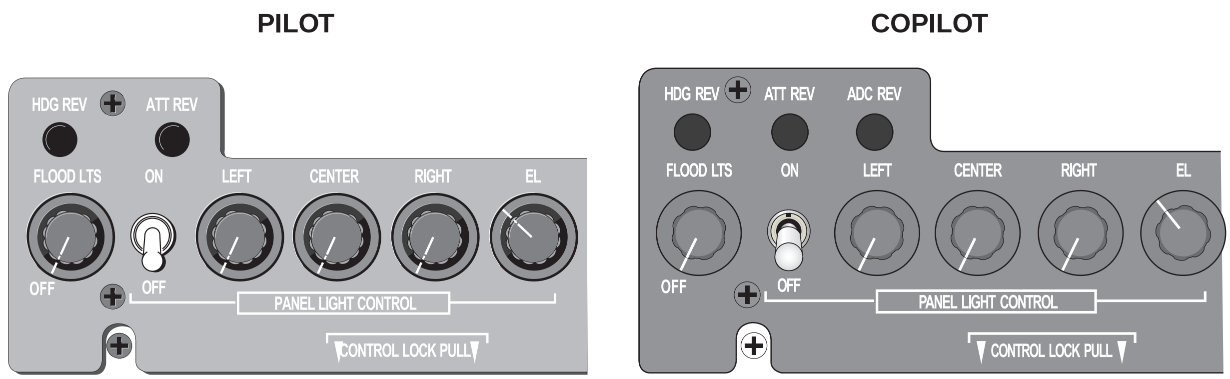
If the vertical angle is computed or set to an invalid value (anything 6.0° or more), the numbers in the VANG box disappear and are replaced by dashes.

Figure 16-9. VNAV Menu Operation (Sheet 4 of 4)

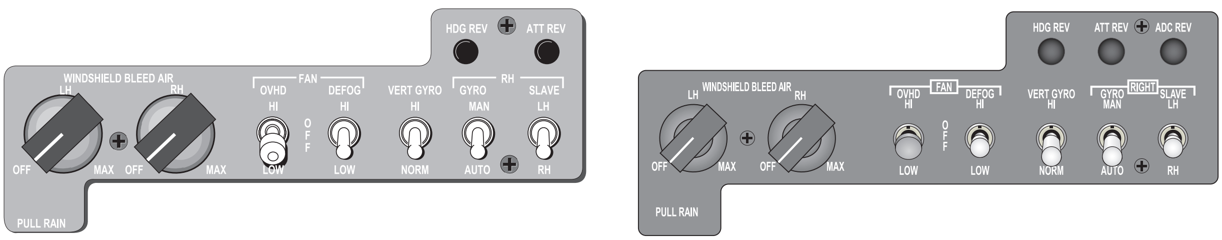
- ***HSI Button:***
  - SNs 0401 and on—Replaced the FULL/WX button (see Figure 16-10). The HSI button toggles the HSI display between the full compass and arc compass displays. If the weather radar is on and the arc display is selected, weather returns are displayed. The power-up default is full compass.
- ***SC/CP***—Selects flight director command bar display. Alternate-action toggles between single cue and cross pointer flight director display. Power-up state is single cue.
- ***GS/TTG Button***—Groundspeed (GS) or time-to-go (TTG) is displayed in the lower right center of the EHSI. Pressing the GS/TTG button provides alternating selection of GS or TTG to next station or waypoint.
- ***ET Button***—Controls elapsed timer that appears in the EHSI location dedicated to GSPD/TTG. Initial actuation enters the mode at the previous position. If elapsed time is being displayed, it stops the display. Sequence of the ET button is: Reset - Elapsed Time - Stop - Repeat.
- ***ADC Button***:
  - SNs 0260 through 0401—Allows pushbutton selection of primary and secondary (cross-side) micro air data computer (MADC). Toggle sequence is: Primary ADC–Secondary ADC–Primary ADC which supplies PFD airspeed, vertical speed and altitude information.
  - SNs 0401 and on—Has been removed from the display controller (see Figure 16-10) and is now on the pilot lower instrument panel as a third reversion switch identified as ADC REV as shown in (Figure 16-11).
- ***NAV Button***—Pressing the NAV button selects the VOR for display on the EHSI course deviation indicator (CDI). Pressing the button alternately selects NAV 1 (green) and NAV 2 (yellow) (annunciated VOR 1 and VOR 2 on the center right side of the EHSI; ILS 1 and ILS 2, if ILS frequency is tuned in NAV). The flight director interfaces with the NAV that is selected and displayed on the EHSI.
- ***FMS***—Selects flight management system (FMS) for display on the EHSI. The EHSI course needle represents FMS course information on the course deviation indicator. The FMS button first depicts onside data in magenta and on second push displays cross-side data in yellow.
- ***Bearing "0" Knob***—This knob has four positions. The OFF position removes the No. 1 (blue) single line bearing pointer from the HSI display. In NAV 1 position, VOR 1 bearing information is displayed. In ADF 1 position, ADF 1 bearing is displayed. Selecting FMS displays bearing to the next FMS waypoint.
- ***PFD DIM (Outer Concentric)***—The DIM knob sets half the overall brightness of the PFD. When a reference level is set, photoelectric sensors maintain the relative brightness level in various lighting conditions. Full counterclockwise OFF position turns off the PFD, and reverts the display, through and EFIS backup mode, to the multifunction display. Sunlight increases intensity so images are still visible.

EFIS backup is provided by the MFD as an addition to the existing symbol generator (EFIS) reversionary modes. In case of failure of a primary flight display (PFD) cathode ray tube, selection of an EFIS backup mode can be accomplished by turning OFF the PFD DIM button on the affected PFD. The MFD then takes up the display selected on the controller. If both PFDs are OFF, the copilot PFD is priority on the MFD display. This is prohibited by limitation.

- ***Decision Height (Inner Concentric-DH)***—Rotation of the DH knob adjusts the decision height display on the EADI in 5-foot increments to 200 feet and 20-foot increments above 200 feet to 990 feet. Rotating the knob fully counterclockwise removes decision height information from the display.



SNs 0260 THROUGH 0400



SNs 0401 AND ON

Figure 16-11. Heading and Attitude Reversion Switches

- ***Test Function (TEST in Magenta)***—Pressing and holding the TEST button is a mandatory test before each flight and causes the displays to enter the test mode. Flags, cautions, and all flight director and mode annunciations are tested and presented on the display. Satisfactory or unsatisfactory test results are annunciated on the display. The test also results in a self-test of the radio altimeter system; 50 feet is indicated in green in the bottom of the EADI display, and the decision height (DH) horn sounds. The TEST button is wired through a squat switch and is completely active only when the aircraft is on the ground. The Primus® 1000 test is not active in flight, but a self-test of the radio altimeter system may be made in flight if the GS capture mode is not active. The EFIS system also automatically self-tests when it is powered up. If the test is not satisfactory it is so annunciated. Holding the test button for more than 5 seconds displays a maintenance test function of the PFD.

- ***Bearing "◊" Knob***—This knob has three positions. The OFF position removes the No. 2 double-line bearing (white) pointer from the HSI display. In NAV 2, NAV 2 bearing is displayed. In ADF 2 position (if installed), ADF 2 bearing is displayed. With only one ADF installed, the ADF 2 needle is inoperative and can not display.

Reversion Switches (HDG REV/ATT REV/ADC REV)

For SNs 0260 through 0401 heading and attitude reversion switches are on the pilot and copilot lower instrument panels. Aircraft SNs 0401 and on an additional ADC REV switch has been added to the right of the HDG REV switch (Figure 16-11).

Heading Reversion Switch (HDG REV)

The heading reversion switch is an auxiliary push-button switch which allows selection of

the opposite side C-14D as an alternate (reversion) heading source for the pilot or copilot flight director. MAG 2 (MAG 1) or DG 2 (DG 1) is annunciated in amber in the center-left of the PFD. The annunciation of MAG or DG is controlled by the position of the respective GYRO MAN/AUTO switch on the pilot or copilot instrument panel. If there is no reversion selection and both systems are selected to their own respective sources, there is no annunciation. If there is a cross-selection on both sides, the annunciation is in white. If the same C-14D is selected as a heading source on both sides, the heading source annunciation is in amber, to apprise the pilots that both indicators are selected to the same heading source.

Attitude Reversion Switch (ATT REV)

The attitude reversion switch is an auxiliary push-button switch which allows selection of the opposite-side VG-14A as an alternate (reversion) attitude source for the pilot or copilot attitude indicator. ATT 2 or ATT 1 is annunciated in amber in the upper-left of the PFD. If the same VG-14A is selected as an attitude source for the attitude indicators on both sides, the attitude source annunciation is in amber; if both systems are selected to their respective sources, there is no annunciation. If there is a cross-selection on both sides, the annunciation is in white. In case of a reversion selection, the annunciation is in amber to apprise the pilots that both indicators are selected to the same heading source.

Air Data Computer Reversion Switch (ADC REV)

For SNs 0401 and on the ADC reversion switch is an auxiliary push-button switch which allows selection of the opposite-side AZ-850 MADC to supply airspeed, vertical speed, altitude information, and BARO set to the PFD as an alternate source for the pilot or copilot air data computer. ADC 1 or ADC 2 is annunciated in amber in the upper-left of the PFD. If the same AZ-850 MADC is selected as the air data source for both sides, the air data source annunciation is in amber; if both systems are selected to their respective sources, there is no annunciation. If there is a cross-selection on both sides, the annunciation is in white. In case of a reversion selection, the annunciation is in amber to apprise the pilots that both indicators are selected to the same air data source.

Primary Flight Display (PFD)

The primary flight display (PFD) on each pilot instrument panel (see Figure 16-2) provides an integrated display of all pertinent flight data. The PFD is divided into four functional sections (Figure 16-12).

Functional Sections

- ***EADI (Attitude Director Indicator) Display***—The EADI symbology uses a truncated sphere format to display standard attitude information. The attitude display receives its inputs from the VG-14A vertical gyro. When either the pitch or roll data becomes invalid, all scale markings are removed, the attitude sphere turns cyan (blue) and a red annunciation of ATT FAIL is put at the top center portion of the sphere.
- ***Mode Annunciations***—The PFD displays mode annunciations from the flight guidance processor (FPG), PFD source selection, and comparison monitor function. Lateral modes to left of center and vertical modes right of top center.
- ***EHSI (Horizontal Situation Indicator) Display***—The PFD HSI heading display receives its inputs from the C-14D directional gyro. HSI displays include a full compass, arc, and weather modes.
- ***Air Data Displays***—The PFD airspeed, altitude, and vertical speed displays receive inputs from the MADC. Various other display data, such as radio altitude, marker beacon, and states of operation annunciations, are also displayed on the PFD.
- ***Standard Slip-skid Display***—Standard slip-skid display is provided by the indicator on the PFD bezel controller (see Figure 16-4).

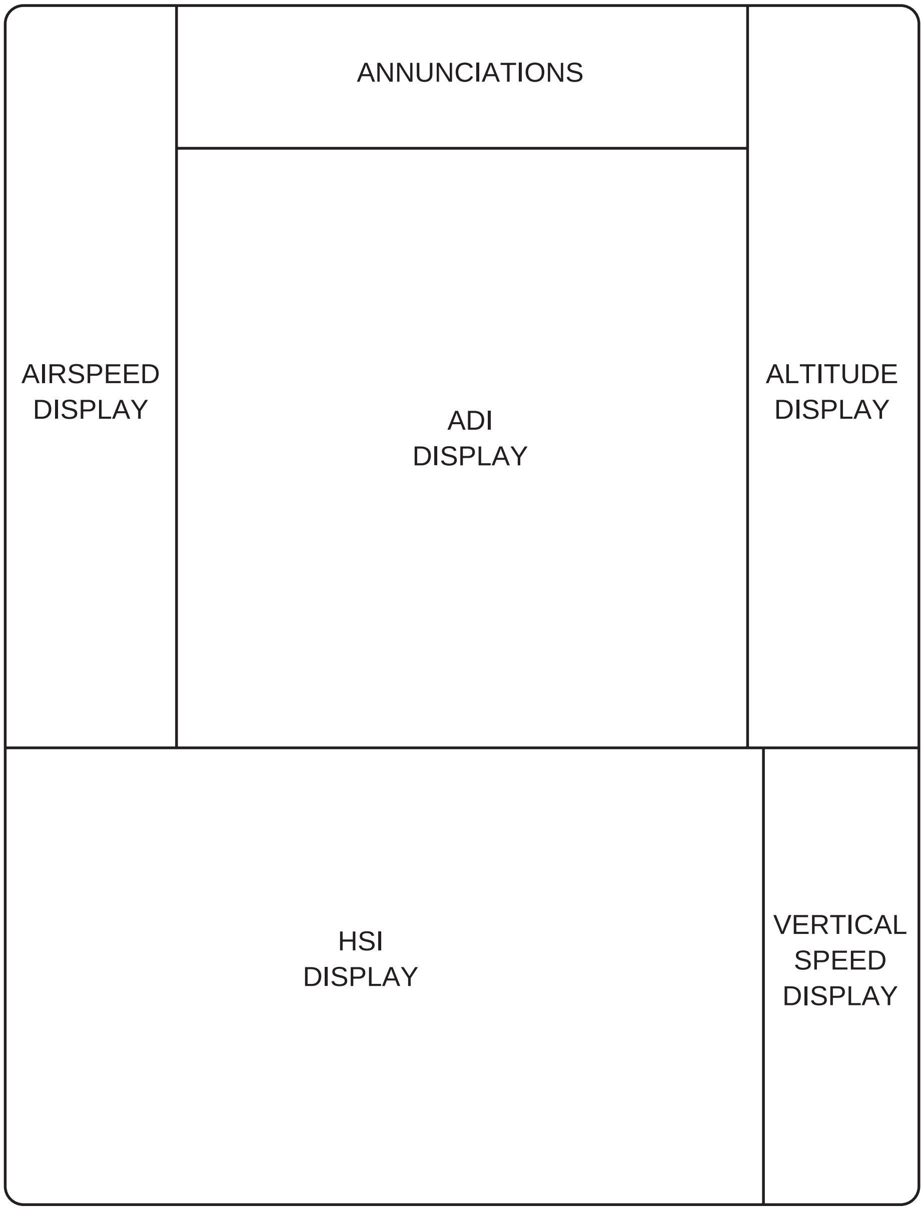


Figure 16-12. PFD Functional Sections

PFD Electronic Attitude Director Indicator (EADI)

The EADI display, shown in Figures 16-13 and 16-14, displays standard attitude information as described below.

Permanent displays are an integral part of the EADI portion of the PFD: the blue (sky) and brown (ground) sphere, the pitch and roll attitude reference marks, the aircraft symbol, and the inclinometer which is fixed to the lower bezel. The flight director command bars are in view on power-up unless there is no lateral mode selected. The single-cue command bar is presented during initial power-up.

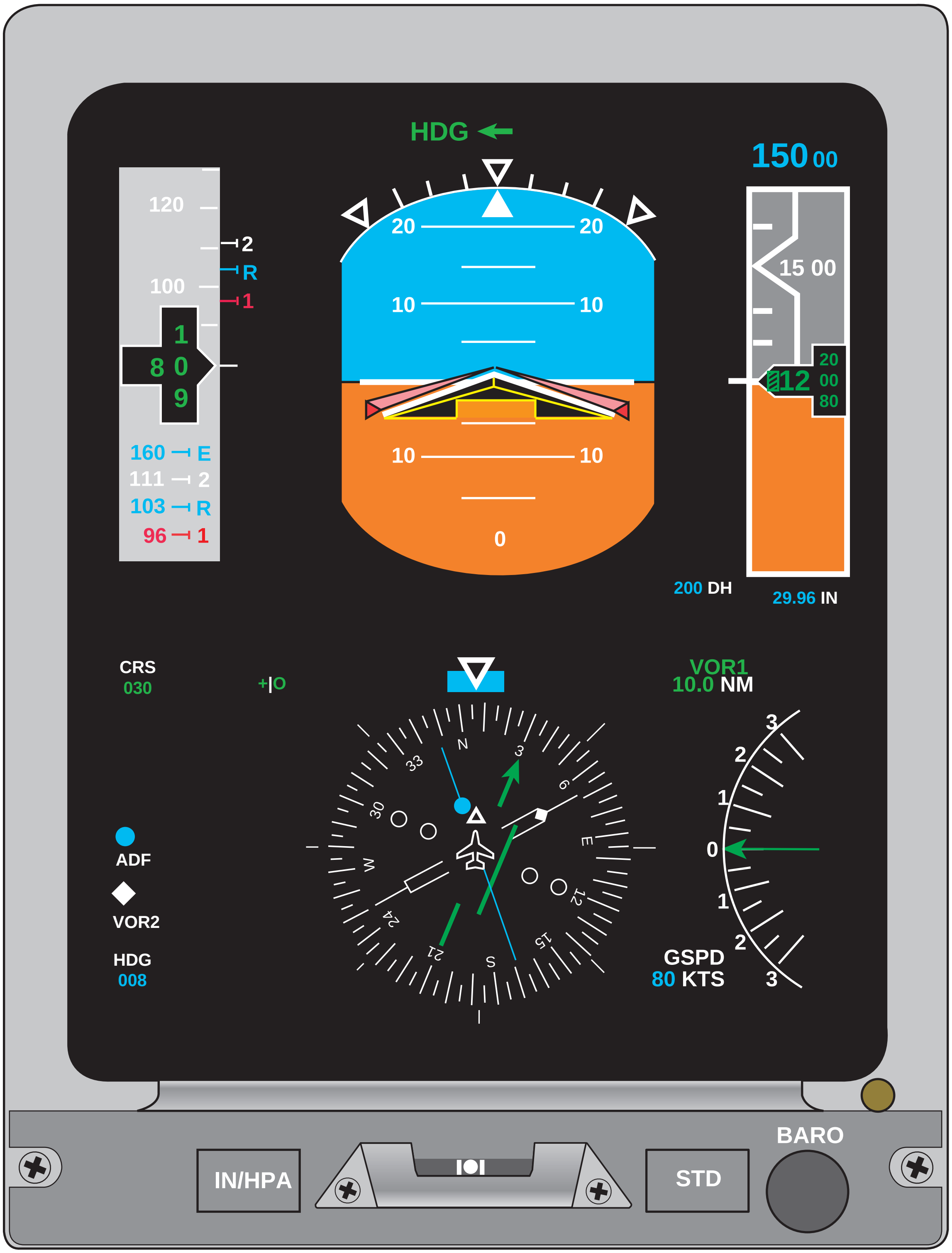


Figure 16-13. PFD EADI Display—Single-Cue Command Bar

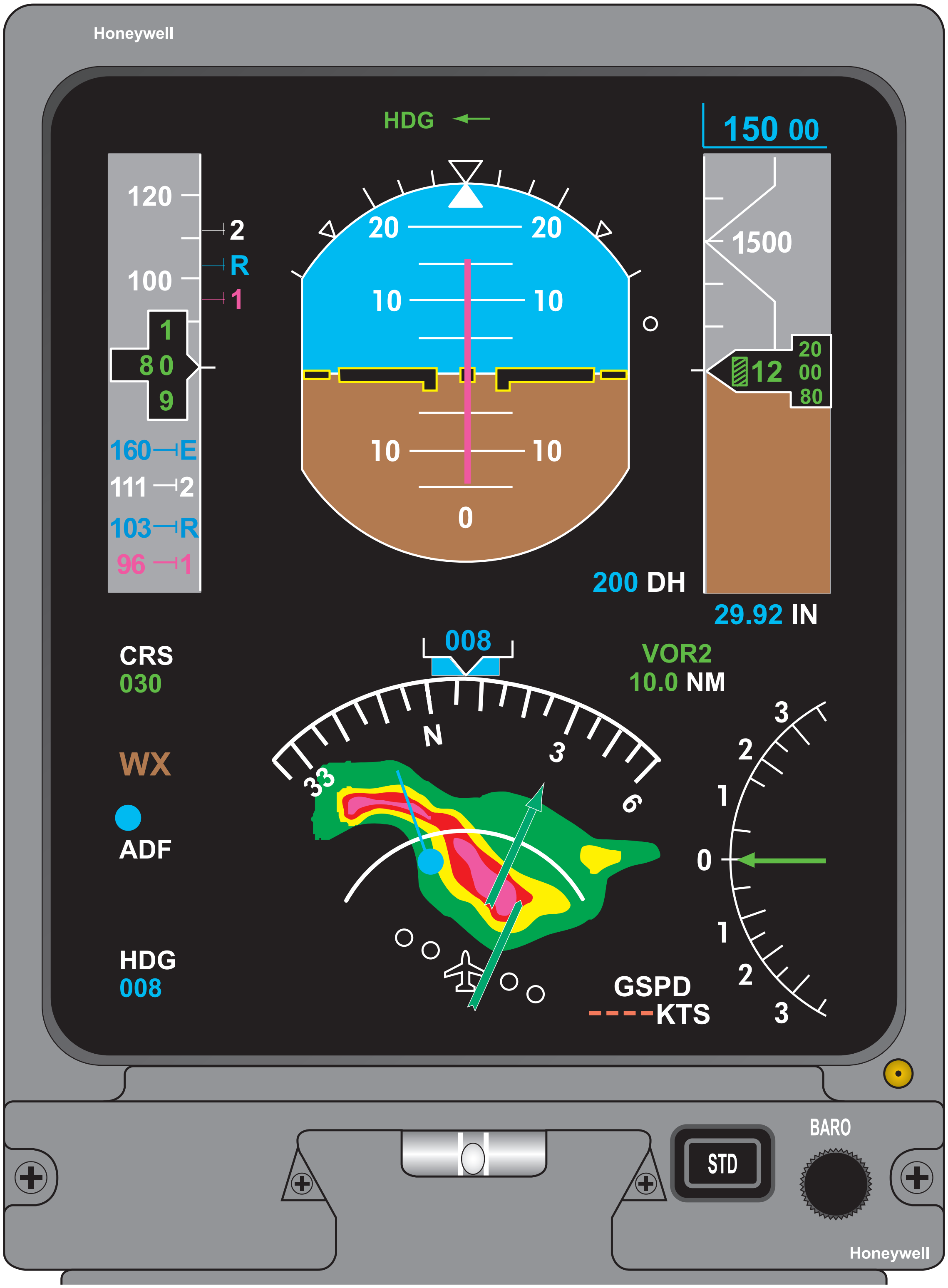


Figure 16-14. PFD EADI Display—Crosspointer Command Bar

Various other symbols and annunciators are displayed when selected or during certain phases of flight:

- ***Decision Height***—The decision height is a three-digit display identified DH (white) in the lower center-right side of the EADI presentation. The value of the decision height is identified in blue numbers. It is set by rotating the DH set knob on the display controller. Full counterclockwise rotation removes the display from view. A decision height annunciation (DH in amber inside a white box) appears in the upper left of the EADI display at radio altitudes less than or equal to the decision height setting and flashes for ten seconds. Decision height is not annunciated until it is armed. Arming occurs when the squat switch senses in air and a radio altitude of 100 feet greater than the selected decision height for at least five seconds.
- ***Radio Altitude Display***—The display of actual radio altitude is in the lower part of the EADI.
- ***Radio Altitude Rising Ground Brown Raster Display***—Another indication of radio altitude is given on the barometric altitude tape. At 550 feet AGL, a rising ground brown raster fills the background of the altitude tape, displacing the normal gray raster field and altimeter scale data. The bottom of the altitude scale corresponds to 550 feet, and the altimeter reference line corresponds to 0 feet. The brown raster fills in the scale proportionately between 550 and 0 feet AGL.
- ***Comparison Monitors***—Amber radio altitude comparison monitor warnings (RA), attitude comparison monitor warnings (ROL, PIT, ATT), and localizer and glide-slope comparison monitor warnings (LOC and GS) are at the lower left side of the attitude display. Parameters monitored are listed as follows:

NOTE

Autopilot operation is prohibited if any comparison monitor annunciator illuminates in flight.

  - Pitch attitude (PIT) ±5°
  - Roll attitude (ROL) ±6°
  - Attitude (ATT)—Active only when both pitch and roll comparators are already tripped
  - Heading (HDG) ±6°
  - Altitude (ALT) ±200 feet
  - Airspeed (IAS) ±5 knots
  - Localizer deviation (LOC) ±40 uA (1/2 dot below 1200 feet AGL)
  - Glide-slope deviation (GS) ±50 uA (1/2 dot below 1200 feet AGL)
  - ILS—Active when both LOC and GS comparators are already tripped
  - Azimuth (AZ) ±38 uA (1/2 dot)
  - Glide path (GP) ± 49 uA (1 dot)
  - MLS—Active when both AZ and GP comparators have been tripped

  The comparison is done when the pilot and copilot have the same type but different sources selected for display. If, for example, the pilot and copilot both have ILS1 selected (amber annunciation of the source), no comparison monitor is active on that data (LOC, GS).

- ***Flight Director Couple Arrow***—The green flight director couple arrow is positioned at the top, center of the PFD. The arrow is pointing left or right to indicate which flight director the autopilot is coupled to. (This display is always present.)
- ***Flight Director Mode Annunciators***—Armed mode annunciations appear in white at the top left (lateral modes) and the top right (vertical modes) of the EADI presentation. Captured mode annunciations appear in green. When a mode is not selected, the annunciation is not present. As a mode transitions from armed to captured, a white box is drawn around the annunciation for five seconds.

- ***Vertical Deviation Scale*****—**The white vertical deviation scale appears on the right side of the attitude sphere. The driver for this scale is selected by the display controller from any one of the following sources:
  - ILS glide slope
  - MLS glidepath
  - VNAV from the FMS or MFD bezel controller

  ILS and MLS pointers are displayed as a green rectangular box. VOR/DME VNAV deviation is displayed as a cyan pointer, and a white VNAV is displayed above the scale. The pointers are amber when both pilots select the same navigation source.
- ***Flight Director Command Cue*****—**The magenta flight director command cues can be selected in single-cue or cross-pointer format by pressing the SC/CP button on the display controller. In the single-cue format, if a lateral mode is not selected, the command bars remain biased out of view. Power-up default selection is single-cue.
- ***Source Annunciations*****—**Source annunciations (ADC1 and ADC2, ATT1 and ATT2, SG1 and SG2) are displayed to indicate the sources of air data, attitude, and symbol generator information, respectively. If the pilot and copilot are using their normal sources, there is no source annunciated. Cross-selections are annunciated in white, and when both displays are selected to the same source, the annunciation is in amber, to remind the pilots of the single source selection. Annunciation is in the upper left section of the EADI display.
- ***Marker Beacon*****—**Marker beacon information appears below the glide-slope indicator when ILS is tuned. A white box, in which the appropriate letter flashes when a marker beacon is passed, is in that position when a localizer frequency is tuned on the NAV control. The outer marker is identified by a blue O, middle marker by an amber M, and inner marker by a white I.
- ***AP (Autopilot) Engage/Disengage*****—**AP engage is annunciated by displaying AP ENG in green on the top center of the ADIs. Warning messages replace this annunciation under appropriate conditions.
- ***TCS (Touch Control Steering) Mode Annunciator*****—**The autopilot (AP) engage annunciator is replaced with an amber TCS annunciator when the TCS switch is pressed.
- ***TRN KNB*****—**Indicates the autopilot turn knob is out of the center detent (autopilot disengaged or engaged).
- ***Category Two Approach*****—**CAT2 (green), annunciated at the upper right of the EADI presentation, indicates that category two approach parameters have been met and the excessive deviation monitor has been enabled. A green category two approach window is displayed around the center of the glide-slope indicator. After a CAT2 condition has been established, if any one of several conditions should go invalid (except for autopilot engaged), the green CAT2 annunciator is replaced by a flashing amber CAT2 legend which flashes for ten seconds and then goes steady. The CAT2 annunciation is removed if the autopilot is disengaged or both DHs are set above 200 feet inclusive.
- ***MAX/MIN SPD (Maximum/Minimum Speed) Warning*****—**When the flight director detects an overspeed condition, a MAX SPD or MIN SPD warning is displayed in amber to the left of the ADI. The warning remains annunciated as long as the overspeed or underspeed condition exists.

MAX SPD is active in SPD/FLC, VS and VNAV flight directors modes; MIN SPD is active only in VNAV mode.

EADI Caution or Failure Annunciations

- ***Flight Director Failure*****—**If the flight director fails, the flight director command bars disappear, and an amber FD FAIL warning appears in the top left center of the display. All FD mode annunciators are removed.

- ***Internal Failures*****—**A large red X covers the face of the PFD.
- ***Radio Altimeter Failure*****—**If the radio altimeter fails, the radio altitude readout is replaced by an amber RA. If the low altitude awareness indication is present, it is removed.
- ***Pointer/Scale Failures Glide slope (Vertical Deviation), Altitude, and Vertical Speed*****—**Failure of pointers/scales is indicated by replacing the digital readouts with dashes, drawing a red X through the scale (IAS, ALT, GS only), and removing the pointer (GS and VS only).
- ***Attitude Failure*****—**Attitude failure is annunciated by appearance of ATT FAIL in red in the upper-half of the attitude sphere. The sphere changes to solid blue, and the pitch scale and roll pointer disappears.

Excessive Attitude Declutter

The EADI display is decluttered if an unusual attitude condition is displayed. If this should occur, the following items are removed from the PFD:

- FD mode annunciations and command bars
- Marker beacons
- Vertical deviation scale, pointers, and annunciators
- ADI localizer scale
- Speed bugs and readout
- Radio altitude and DH set
- Altitude select data
- All flags and comparators except ATT and ADC(IAS/ALT)

An unusual attitude condition is defined as:

- Bank greater than 65° roll
- Pitch greater than 30° up or 20° down

PFD Electronic Horizontal Situation Indicator (EHSI)

The EHSI display shown in Figure 16-15 displays information as described below.

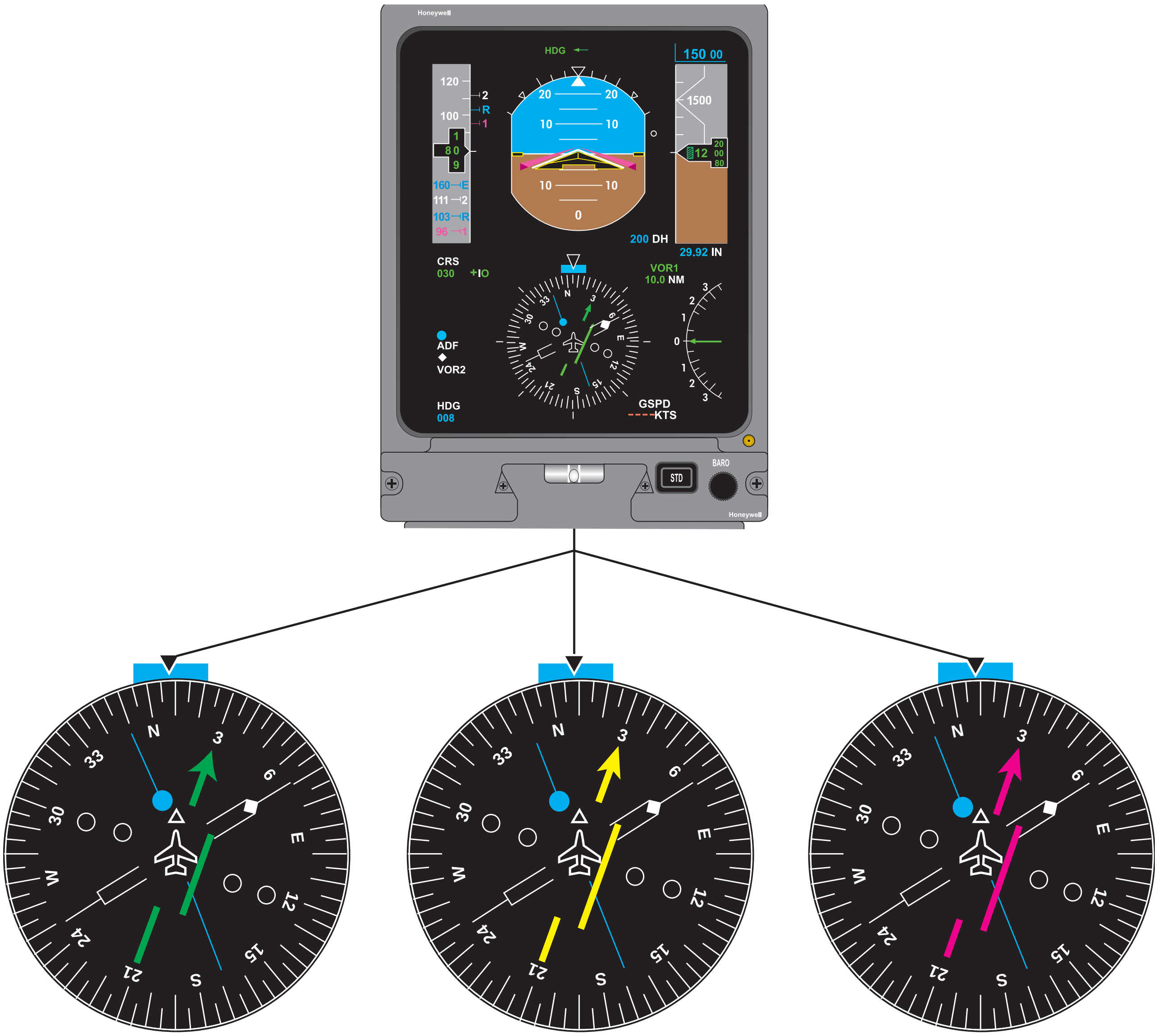
The EHSI function of the PFD has full-time displays which are always present, part-time displays which are sometimes present, and the 90° arc compass mode.

Full-Time Displays

The aircraft symbol is present and provides a visual cue of aircraft position relative to a selected course or heading. Other full-time presentations are similar to those on a mechanical HSI.

- ***Heading Dial and Digital Heading Readout*****—**Heading information is presented on standard-type compass dial format, and digital heading readout is shown above the heading dial when in the ARC mode.
- ***Heading Select Bug and Heading Select Readout*****—**The heading bug is positioned around a compass dial with the HEADING knob on the remote instrument controller (Figure 16-16). The bug then retains its position in relation to the dial. A digital heading select readout is provided at the lower left of the display (cyan or blue digits, white HDG label). The heading bug provides a heading error signal to the flight director.

Figure 16-16. Remote Instrument Controller



GREEN

Both pilots have selected their on-side NAV source.

YELLOW

Both pilots have selected same-side NAV source
or...
both pilots have selected cross-side NAV source
or...
both pilots have selected FMS.

MAGENTA

One pilot selects FMS, and the other pilot not selected to the same FMS.

Figure 16-15. PFD EHSI Display

- ***Course Deviation Indicator*—**Navigation or localizer course. Course deviation and aircraft position relationships are depicted as on a mechanical HSI instrument. The course deviation indicator also operates in conjunction with the long-range NAV system. Refer to Part-Time Displays, below, for Desired Track information. The CDI is positioned by the COURSE knob on the remote instrument controller. The COURSE knob is not functional when FMS mode is selected. The CDI is magenta when FMS course information is presented, green when on-side NAV information is being presented, and yellow when off-side NAV information is being presented.
- ***Course Pointer with Display*—**The course pointer rotates about the center of the arc heading display. With a short-range NAV selected, the course pointer is positioned by rotating the COURSE knob on the remote instrument controller.
- ***TO/FROM Annunciator*—**Indicator points along selected course, depicting whether the course generally takes the aircraft to or from the selected station or waypoint. Indicator does not appear during localizer operation.
- ***Distance Display*—**Indicates nautical miles to selected station or waypoint. Distance display is in 0-399.9 NM for selection of short-range navigation equipment and 0-3999 NM format for long-range equipment. DME HOLD is indicated by an amber H next to the readout.
- ***Navigation Source Annunciators*—**NAV source annunciations are displayed in the upper right corner of the EHSI presentation. Long-range sources are in magenta, and short-range sources are in green or yellow. A yellow indication means an off-side selection or that both sources are the same. The label identification is always white. A yellow annunciation of FMS indicates that both pilots are selected to the FMS.
- ***Heading Source Annunciation*—**Heading source is annunciated at the top left center of the EHSI presentation. A green annunciation indicates a normal selection, and amber indicates an off-side selection or that both selections are the same (MAG1/MAG2 or DG1/DG2).
- ***Heading SYNC Annunciator*—**The heading SYNC annunciation is to the left of the heading source annunciation in the upper left side of the EHSI presentation. The bar in the indicator represents commands to the compass to slew in the indicated direction. Plus indicates an increase in heading, and zero indicates a reduction in heading. Slow oscillation indicates normal operation. During compass MAN (DG) modes, the annunciation is removed.

Part-Time Displays

Part-time displays are present when selected on the display controller or the flight director mode selector panel. The mode and bearing pointers available depend upon optional equipment installed and may not be present in all installations. Some annunciations also concern other systems, which is discussed under headings pertaining to those systems.

- ***Bearing Pointer and Source Annunciation*—**The bearing pointers indicate relative bearing to the selected navaid and can be selected as desired on the display controller. Bearing pointers appear on the compass rose when they are selected by means of the knobs on the display controller, and the bearing pointer source annunciations are in the lower left of the EHSI display. If NAV source is invalid or LOC frequency is tuned, the NAV bearing pointer and the annunciation disappears. The 0 bearing pointer is always NAV 1, ADF 1, or FMS. The "◊" bearing pointer is always NAV 2 or ADF 2 (if installed).
- ***Elapsed Time Annunciation*—**Shows elapsed time in hours and minutes or minutes and seconds. Selection is made on the display controller.

- ***Time-to-Go and Ground Speed***—Pressing the GS/TTG button on the display controller alternates time to go (to next waypoint or navaid) and groundspeed displays.
- ***Desired Track***—When long-range navigation is selected, the course pointer becomes a desired track pointer. The long-range NAV system positions the desired track pointer. A desired track (DTRK) digital display appears in the upper left corner of the EHSI display. When FMS is selected, the course selection knob on the remote instrument controller is inactive.
- ***NAV Source Annunciation***—Appears in the upper right side on the EHSI presentation when a NAV, ILS, or FMS source is selected as a navigation source. Distance to next waypoint or to selected VORTAC appears below the annunciation. Annunciated source is displayed on the EHSI course deviation indicator (CDI) by changing colors.
- ***Wind Display***—The wind display (magenta direction and arrow) is at the lower left-center of the display when FMS is selected for navigation.
- ***Weather Radar Modes***—Along the left top side of the EHSI display are the displays of the weather radar modes. These modes and displays are discussed under Weather Radar later in this chapter.
- ***Drift Angle Bug***—If available from the FMS, the drift angle bug with respect to the lubber line represents drift angle left or right of the desired track. The drift angle bug with respect to the compass card represents the aircraft actual track. The bug is displayed as a green triangle that moves around the outside of the compass card (in either FULL or ARC mode).
- ***FMS Waypoint (WPT) Alert***—Sixty seconds prior to crossing an FMS waypoint the amber WPT annunciator is displayed to the left of the compass rose. The annunciator flashes during this time.
- ***FMS Status Annunciation***—Some critical FMS status annunciations are annunciated to the left of the compass: waypoint (WPT), offset (XTK), approach (APP), degrade (DGR), and dead reckoning (DR). XTK and APP are displayed in cyan; DR, DGR, and WPT are displayed in amber. Message (MSG) is displayed to the right of the compass in amber.
- ***Bearing Pointer and Source Annunciations***—Two bearing pointers are available: circle symbol and triangle symbol. The bearing pointers indicate bearing to the selected navaid. The pointers are selected using the display controller.
- ***Desired Course/Track Annunciations***—A desired course/track (lateral) deviation scale appears in the form of two white dots on either side of the aircraft symbol. This represents the NAV deviation from the selected source. The lateral deviation dots rotate around the center of the fixed aircraft symbol.
- ***Wind Vector***—Wind vector information is displayed in the left bottom center. The wind is shown in magenta with velocity and direction. Wind information is provided by a vector arrow showing the direction of the wind relative to the aircraft symbol. The associated digital quantity indicates wind velocity.

Arc Display (Partial Compass Format)

During operation in the arc (WX) mode (Figure 16-17), additional presentations are available which enhance navigation and safety of flight. Pressing the FULL/WX button on the display controller toggles the display between the full and partial compass display. Additional features presented in partial display are the following:

- ***Off-Scale Arrows***—In the arc mode, the heading bug and course/desired track course pointer can be rotated off the compass scale. When the HDG bug is off scale, a cyan arrow is displayed on the outer compass ring to indicate the shortest direction to its location.

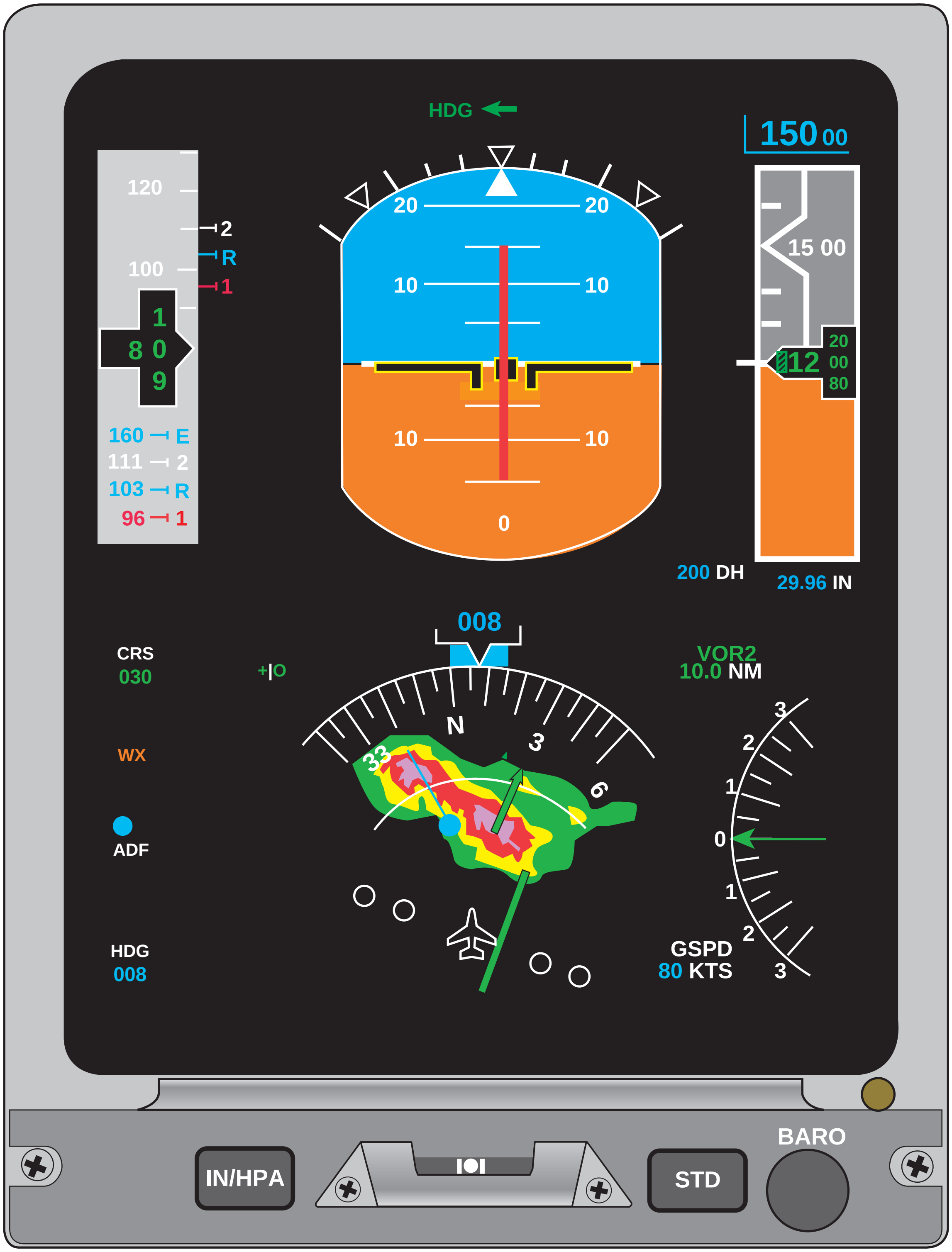


Figure 16-17. EHSI Arc Mode

- ***Range Rings***—Display of the range rings aids in the use of radar returns when WX mode is selected. The center half-range ring represents the selected radar range. The range is controlled by the weather radar controller.
- ***Weather***—Weather radar returns are displayed on the EHSI when WX mode is selected on the display controller. WX mode forces the PFD into arc display if it was not already selected. Radar mode annunciations are presented on the upper left side of the EHSI presentation and on the lower left side of the multifunction display (MFD) as depicted in Table 16-1.

EHSI Caution or Failure Annunciations

Amber caution annunciations appear to indicate the following situations:

- ***DME Hold***—When the DME is selected to HOLD, an amber H appears to the left of the DME readout on the EHSI.
- ***FMS Alert Messages***—Waypoint (WPT), dead reckoning (DR), or degrade (DGR) messages appear in amber at the upper center-left of the EHSI presentation to indicate, respectively, that a waypoint is being passed, the FMS is in dead reckoning, or the FMS navigation has become degraded for any of various reasons. MSG annunciated in amber at the top center-right of the EHSI display indicates that the FMS has a message on the FMS CDU.
- ***Digital Display Cautions***—When DME, groundspeed (GSPD), time-to-go (TTG), or elapsed time (ET) digital readouts fail, the digital display is replaced by dashes.
- ***Target Alerts***—An amber TGT on the left of the EHSI indicates weather radar target alert. A green TGT annunciation indicates that target mode has been selected on the weather radar.
- ***Digital Readouts***—Failure of the course or heading select signals causes these displays to be replaced by amber dashes. They are also dashed when the heading display is invalid.

Table 16-1. WEATHER RADAR ANNUNCIATION

R/T MODE	MODE ANNUNCIATION	ANNUNCIATION COLOR
R/T in Warmup	WAIT	Green
REACT Mode	RCT	Green
Ground Clutter Reduction	GCR	P870 option
RCT and GCR Modes Active	GR/R	P870 option
Forced Standby	FSBY	Green
Standby	STBY	Green
Test Mode	TEST	Green
Weather Mode	WX	Green
Variable	VAR	Amber
Weather and Turbulence	WX/T	P870 option
RCT and Turbulence	R/T	P870 option
Ground Map Mode	GMAP	Green
Flight Plan Mode	Green	FPLN
R/T Fail	FAIL	Amber
R/T Off	OFF	Green

NOTE:
A magenta TX is displayed in the same area when radar is transmitted but is not selected for display on the PFD.

- ***Heading Source and Navigation Source*****—**When both the pilot and copilot select the same heading source or NAV source, the source annunciators are amber. If the NAV or heading sources are cross-switched, i.e., pilot to copilot and vice versa, the annunciation also is in amber. Normal selections are not annunciated.
- ***Heading Comparator Warning*****—**HDG annunciated in amber at the top center-left of the EHSI display indicates that the comparing system has detected an excessive difference between the two heading indicators.

Red failure annunciations appear in the following instances and locations:

- ***Heading Failure*****—**A heading failure results in the following indications: heading and bearing annunciations and bearing pointers disappear; HDG FAIL appears at top of heading dial; HDG, CRS SEL, and DTRK dash.
- ***Deviation Indicator Failures*****—**A failure in the vertical deviation or glideslope system results in removal of the applicable pointer and a red X being drawn through the scale.
- ***Vertical Speed Display*****—**A red X is drawn through the scale.

Air Data Displays

Air data information on the PFDs consist of airspeed, altimeter, and vertical speed displays. The micro air data computers (MADCs), fed by two independent primary pitot-static systems and a dedicated air temperature probe (Rosemont) on the lower right side of the nose, provide data to the IACs for processing and formatting air data displays on the PFDs.

Airspeed Displays

The airspeed section of the PFD display is to the left of the ADI display (Figure 16-18, Sheet 1). The display consists of a rolling digit window in the center of an airspeed vertical tape. The resolution in the window is in 1-knot intervals. The moving vertical tape moves behind the window and displays airspeed at 20-knot intervals. The tape rolls downward; larger numbers roll down from the top of the scale. The range of speed is 40 to 400 knots with tick marks at 10-knot intervals.

- ***Trend Vectors*****—**An airspeed trend vector (magenta), which displays an indication of the direction and rate of airspeed change, extends vertically from the apex of the current airspeed value display window (Figure 16-18, Sheet 1). It extends upward for acceleration and downward for deceleration. The trend vector represents a prediction of what the airspeed can be in 10 seconds if the current change in airspeed is maintained.
- ***V-Speed Indications*****—**Bugs for six V-speeds are provided to allow pilot selection of key airspeeds by means of the multifunction display (MFD) bezel buttons (see Figure 16-5). They are labeled 1 (V_1), R (VR), 2 (V_2), and E V_{ENR}) (Figure 16-18, Sheet 1) (this airspeed is automatically displayed whenever V_1, VR, or V_2 is selected for display) and RF (V_{REF}) and AP (V_{APP}) (Figure 16-18, Sheet 5). When the takeoff speeds are selected, digital indications appear at the bottom of the PFD display, as well as the bugs being placed into position. The bugs are positioned on the right outside edge of the airspeed tape. They consist of a horizontal T-shaped symbol with its respective label positioned to the right of the symbol. All the takeoff set bugs are removed from the display when the aircraft airspeed exceeds 230 knots, and the landing speed bugs are removed when power is turned off.

  When the airspeed is below 40 knots, V_1, VR, V_2, and VE are displayed in the bottom portion of the airspeed tape in the form of a digital readout. The digital readout of the set value is displayed along with the bug symbol and are labeled in ascending order, starting with V_1. Upon power-up, the digital readouts for the set bugs are amber dashes. As the V-speeds are set on the MFD menu, the digital readouts follow the readout on the MFD and set accordingly. The digital readouts are removed from the display at weight-off-wheels.

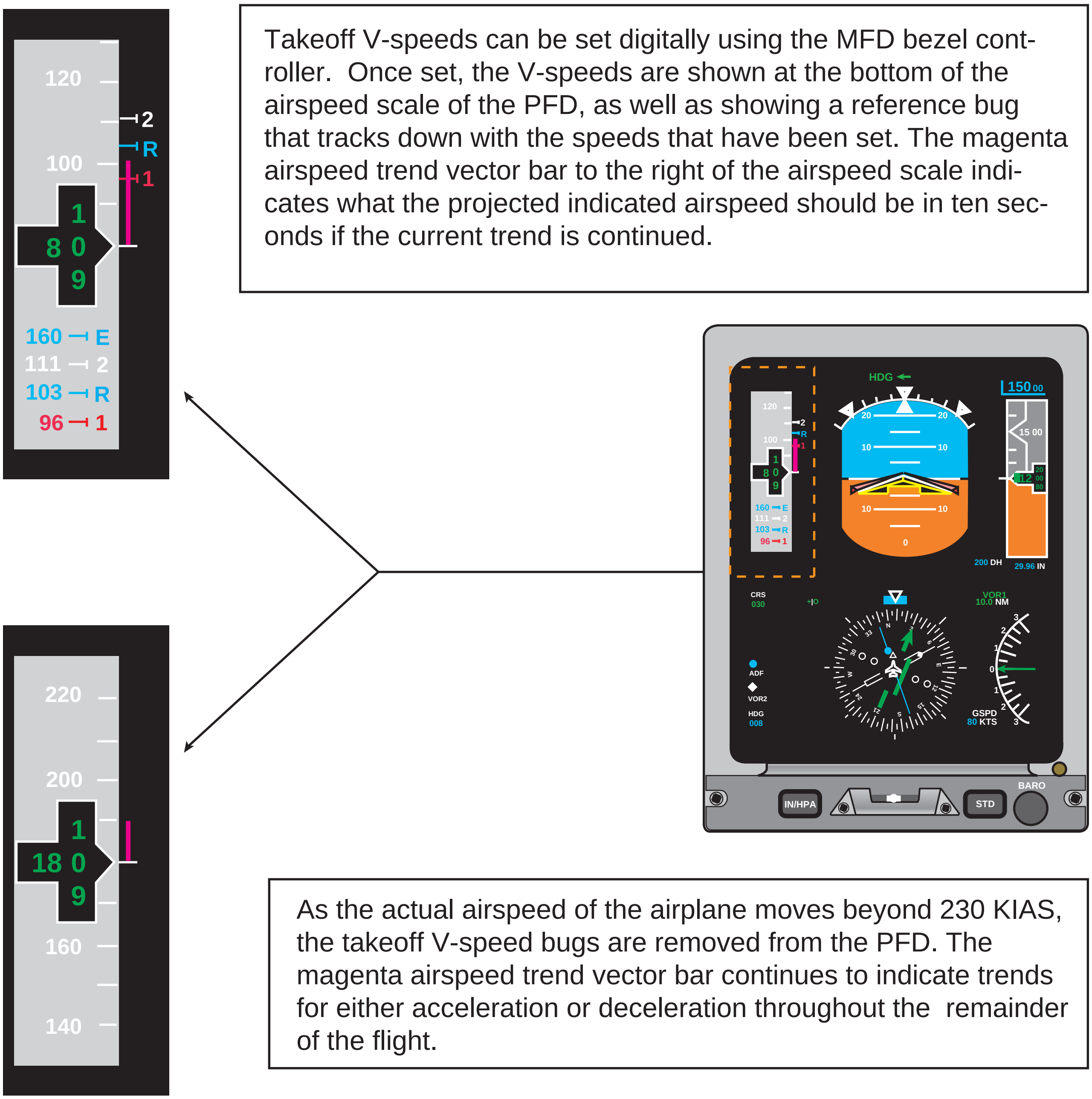


Figure 16-18. PFD Airspeed Display (Sheet 1 of 5)

- ***Standby Airspeed*****—**Conventionally generated airspeed is always available in case of complete electrical failure. This system is discussed later in this chapter under Emergency Flight Instruments.

NOTE

The flight guidance system annunciates the SPD command in terms of IAS or MACH (if programmed) at the top of the airspeed scale (see Figure 16-18, Sheet 2).

- Overspeed Indications—Below 8,000 feet altitude the limiting airspeed (V_{MO}) is 261 KIAS; between 8,000 and 28,907 feet the limiting airspeed is 292 KIAS. When one of these limits is exceeded, the airspeed indication in the window is changed to red and an amber annunciation. Also, to the left of the attitude sphere MAX AIRSPEED is illuminated. A red thermometer-type tape is also presented on the inside of the airspeed scale (Figure 16-18, Sheets 2 and 3). The thermometer extends from V_{MO}/M_{MO} to larger airspeeds on the tape and appears in the indication as the airspeed reaches into the range near V_{MO}/M_{MO}. When the limiting airspeed is exceeded, the overspeed warning horn sounds and continues to sound until the airspeed is reduced below the limit speed.
- ***Low Airspeed Awareness*****—**A red, amber, and white thermometer-type display on the inside of the airspeed scale gives indication of low airspeed as calculated by the AOA input. The white extends from 1.3 to 1.2 VS1, the amber band extends from 1.2 to 1.1 VS1 (approximately stick shaker speed), and the red extends from stick shaker speed to the smaller airspeeds on the tape (see Figure 16-18, Sheet 4).
- ***Mach Number Display*****—**A digital readout of indicated Mach number is displayed below the airspeed dial. The Mach number comes up on the display when Mach exceeds 0.390 and is removed when it falls below 0.380 Mach. Resolution of the Mach display is 0.01 Mach (see Figure 16-18, Sheet 2 and 3).

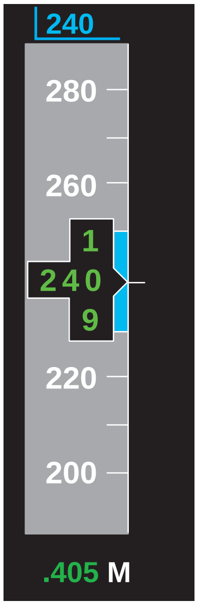
Altitude Indications

The altitude display is to the right of the EADI (Figure 16-19, Sheet 1). The altitude tape is a moving scale display with a fixed pointer (center of window). The scale markings on the tape are labeled in 100-foot increments. The scale tape displays larger numbers at the top.

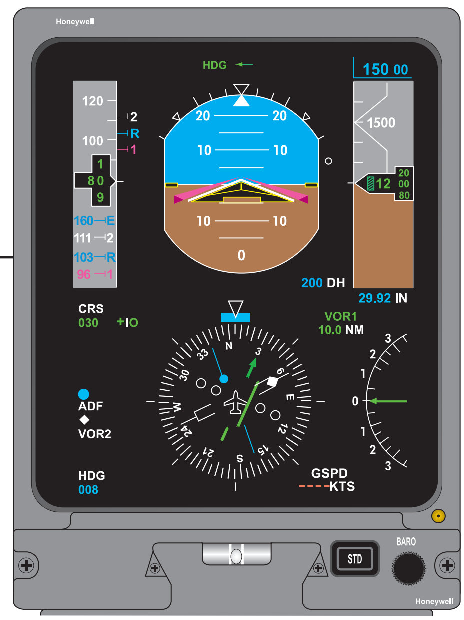
The range of altitude window is from –1,000 to 60,000 feet with tick marks at 500-foot increments. The scale is labeled in 500-foot intervals, and single-line chevrons are at each 500-foot increment. Double-line chevrons are at each 1,000-foot increment. The chevrons extend back to the approximate midpoint of the altitude tape and are connected with each other by a vertical line. The left side of the rolling digit window has the same angle as the chevrons.

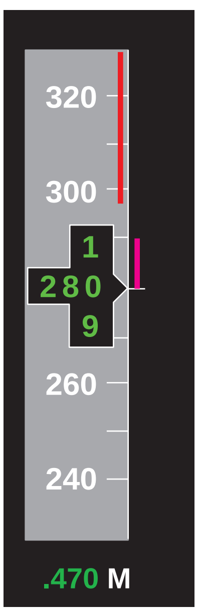
- ***Altitude Digital Display*****—**A digital display (green) of the actual altitude value is contained in the display window. This data is a magnification of the digits on the scale and is readable to within a 20-foot resolution. The digits within the pointer scale are white. For climb/descent rates greater than 1,000 feet per minute, the rolling drum digits are replaced by two dashes to enhance altitude scale readability. Below 10,000 feet, boxed hash marks are used to show that the ten-thousand-foot digit is missing (Figure 16-19, Sheet 1).
- ***Altitude Alert Select Display*****—**Altitude alert select data is displayed at the top of the altitude scale. This data is set by using the right-side MFD bezel set knob (see Figure 16-5).

The altitude preselect data is cyan (blue). When the aircraft is within the altitude alert region (± 1,000 feet), the box and the set data turn amber. When a departure from the selected altitude capture occurs, the select data also changes back to amber. When the aircraft approaches the set altitude, within 250 feet, the box and the altitude data turns back to cyan (blue). A momentary audio alert sounds when the aircraft is 1,000 feet from the preselected altitude or has departed 250 feet from the select altitude after capture.



When the flight director SPD/FLC mode is engaged, the desired airspeed is displayed above the airspeed scale, and an airspeed bug appears on the right side of the airspeed scale. If the desired airspeed is not on the scale, half of the bug appears at the top or bottom of the scale to indicate the required change to achieve the desired speed. The digital Mach speed display appears when the indicated Mach is at least .38 Mach. The color of the digits match the digits in the rolling airspeed window.





As the airspeed increases, a red bar appears on the right side of the airspeed scale when the V_{MO} speed comes onto the scale. The red bar is the overspeed bar, which originates at V_{MO} and continues to the top of the scale.

Figure 16-18. PFD Airspeed Display (Sheet 2 of 5)

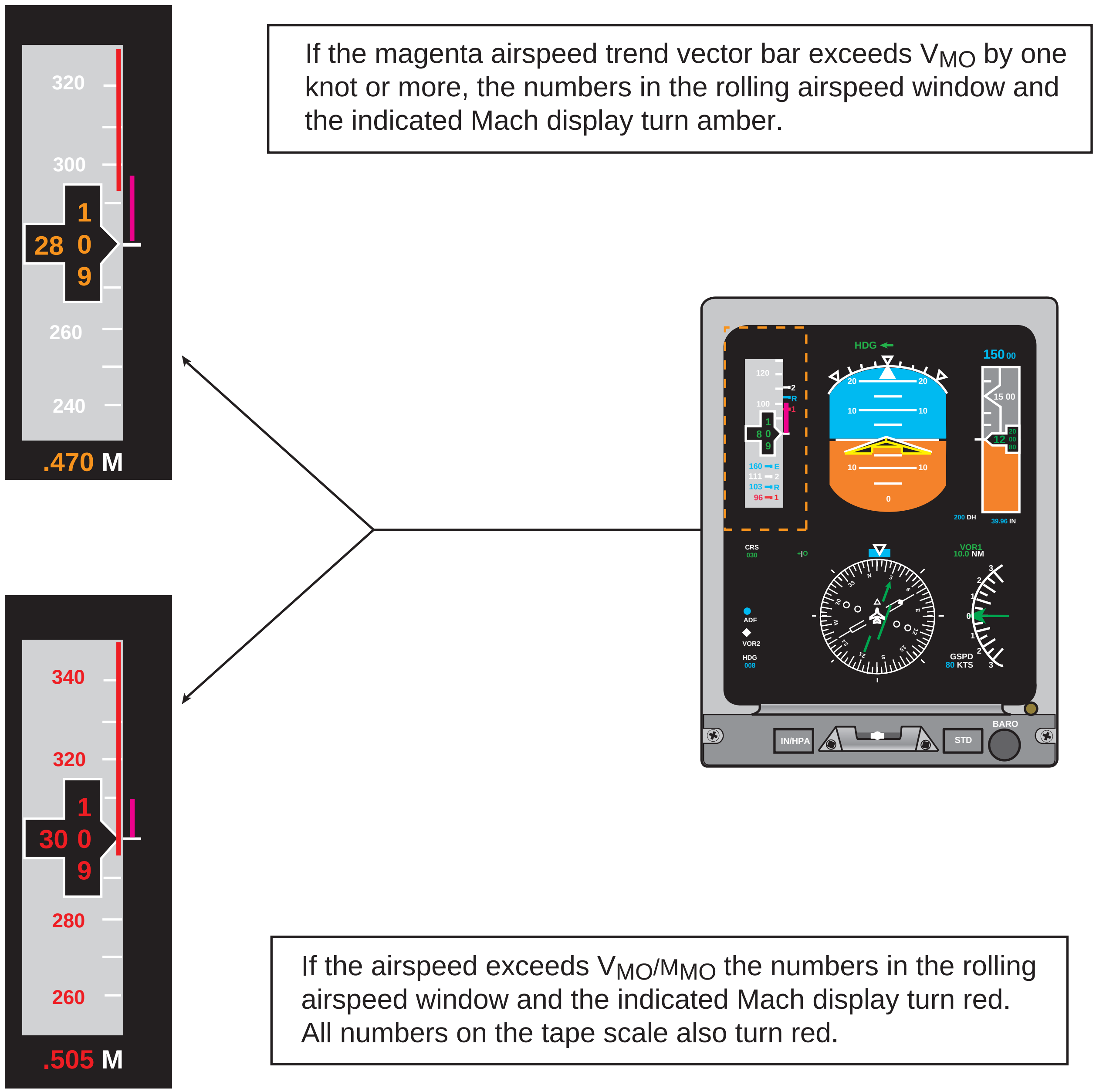


Figure 16-18. PFD Airspeed Display (Sheet 3 of 5)

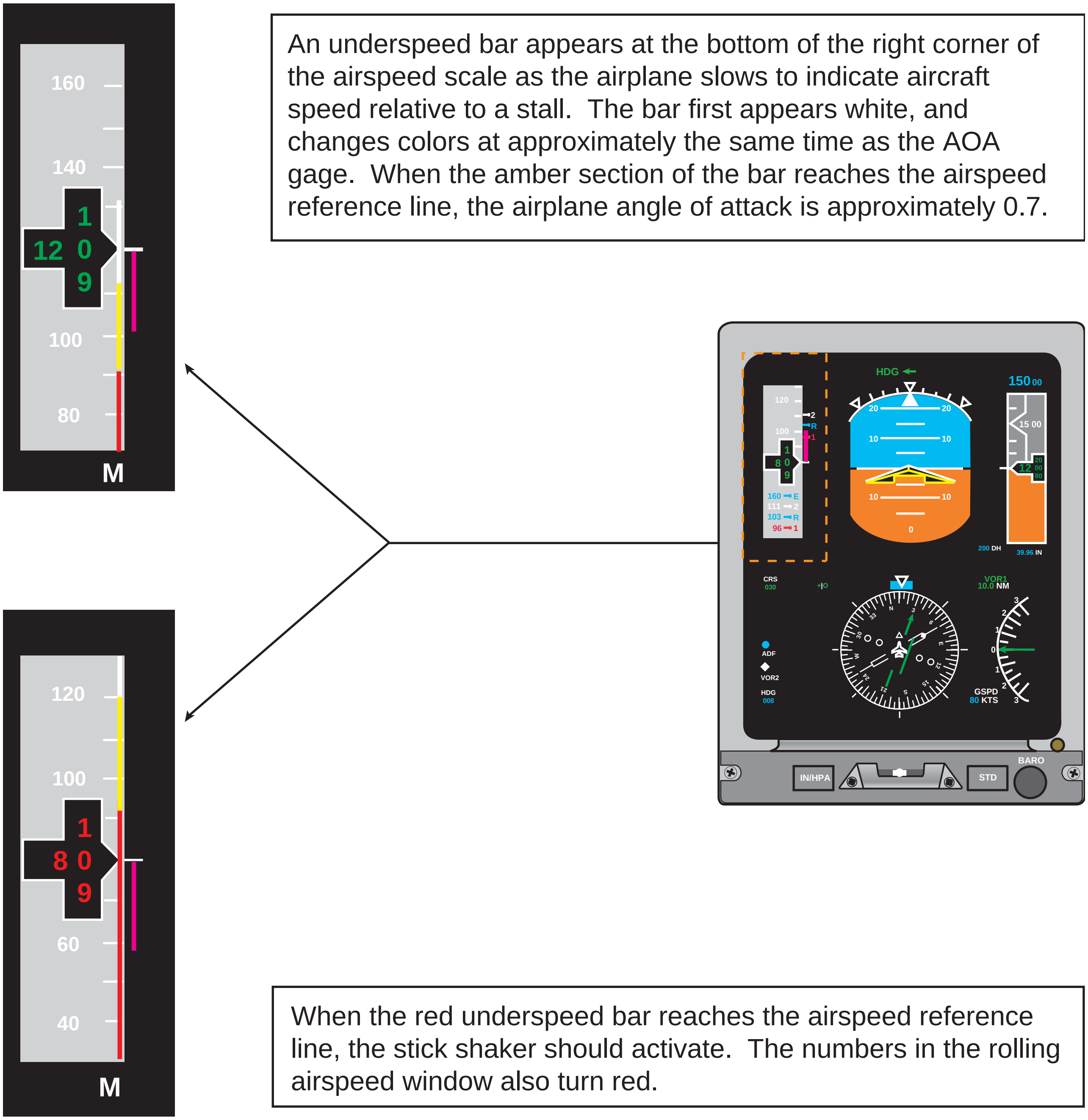
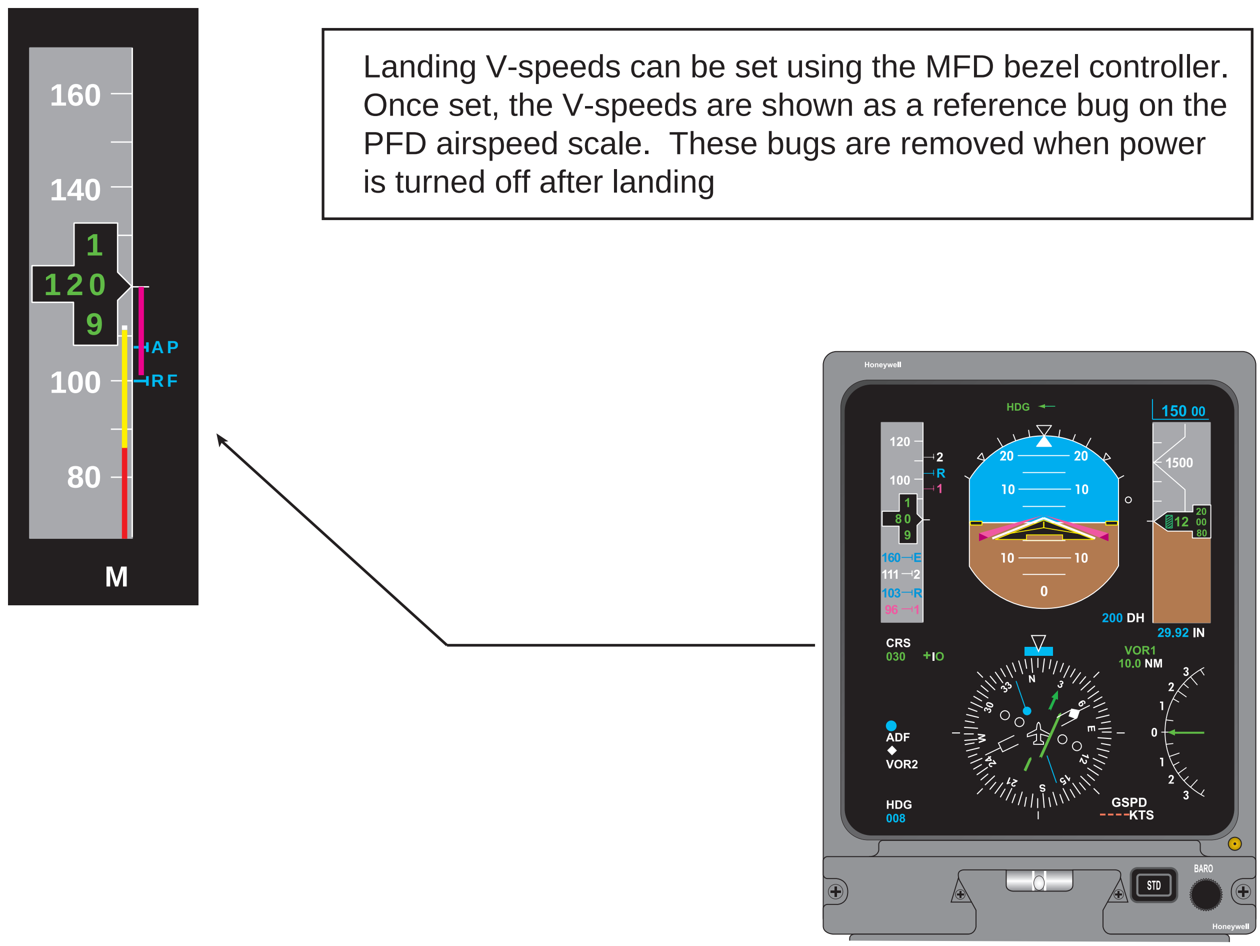


Figure 16-18. PFD Airspeed Display (Sheet 4 of 5)

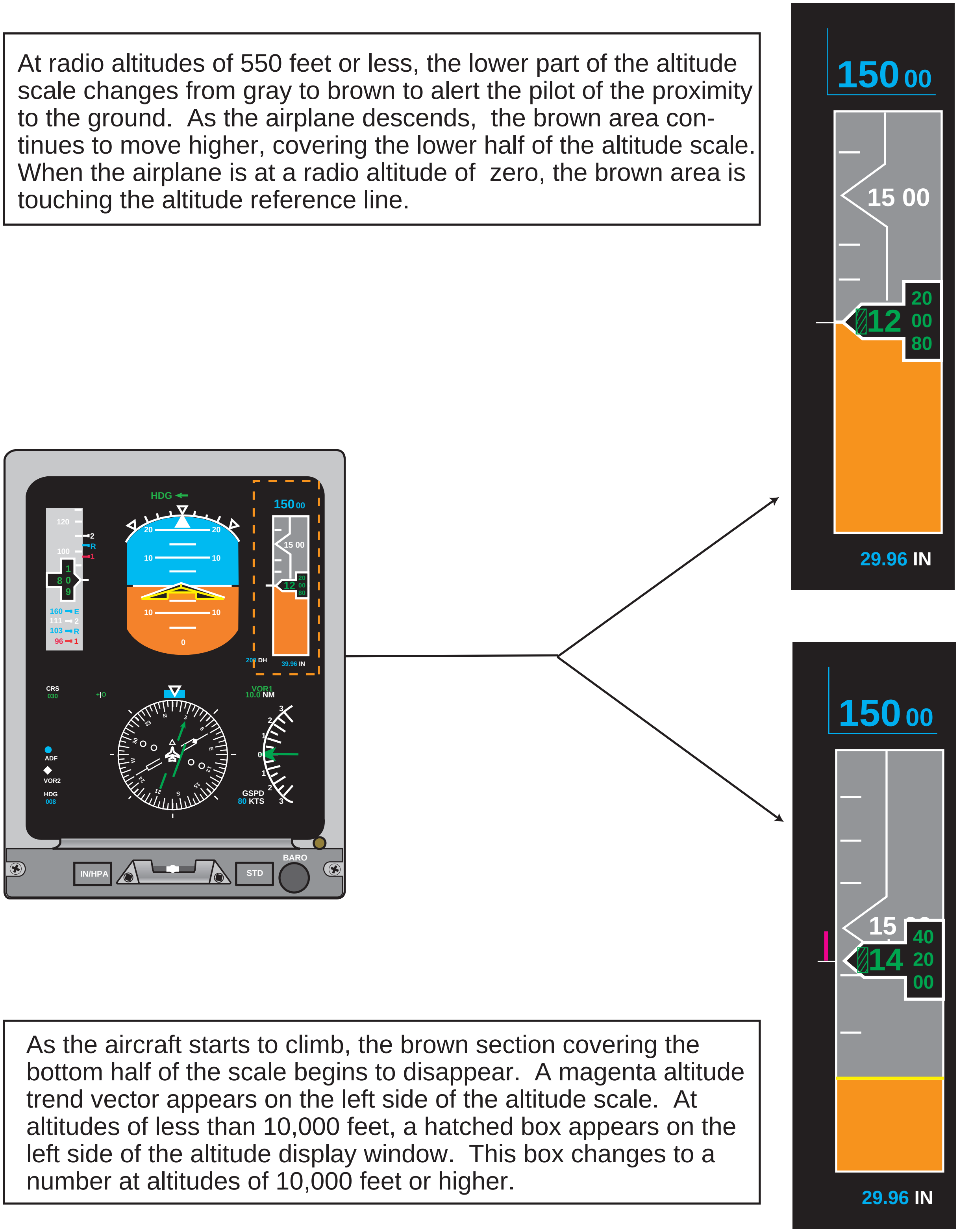


NOTE:
Some installations are programmed with the larger numbers coming from the bottom of the display. For these airplanes, the airspeed trend vector bar is not available.

NOTE:
If the flight director is not in the SPD/FLC mode, the flight director airspeed bug and the airspeed target and target box are removed from the display.

Figure 16-18. PFD Airspeed Display (Sheet 5 of 5)

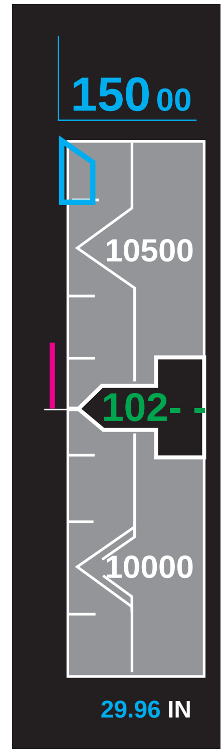
At radio altitudes of 550 feet or less, the lower part of the altitude scale changes from gray to brown to alert the pilot of the proximity to the ground. As the airplane descends, the brown area continues to move higher, covering the lower half of the altitude scale. When the airplane is at a radio altitude of zero, the brown area is touching the altitude reference line.

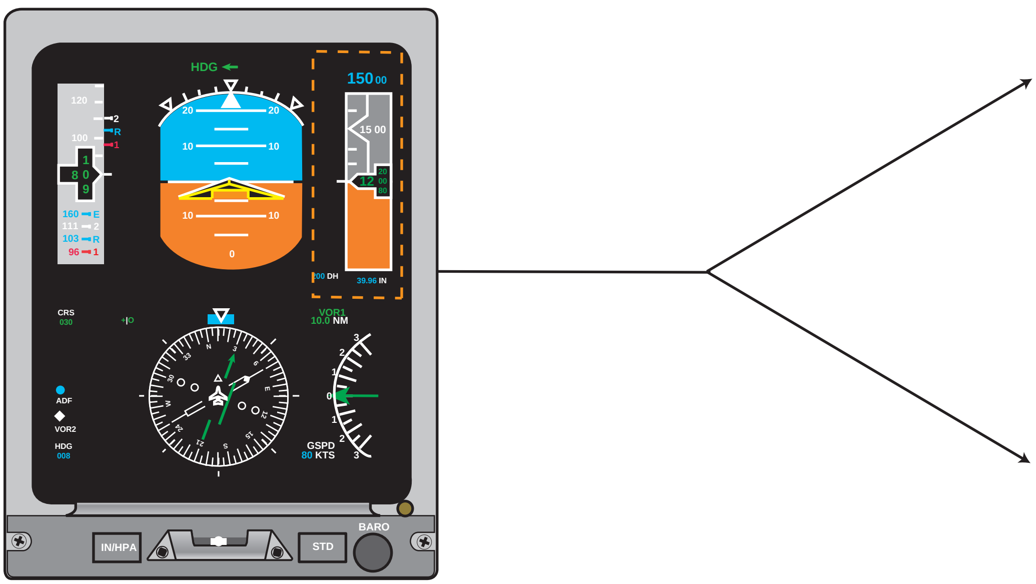


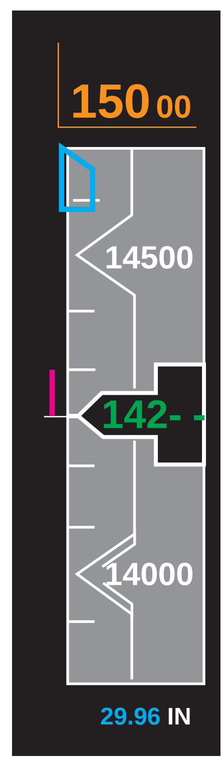
As the aircraft starts to climb, the brown section covering the bottom half of the scale begins to disappear. A magenta altitude trend vector appears on the left side of the altitude scale. At altitudes of less than 10,000 feet, a hatched box appears on the the left side of the altitude display window. This box changes to a number at altitudes of 10,000 feet or higher.

Figure 16-19. PFD Altitude Display (Sheet 1 of 3)

When an altitude is preselected, a cyan altitude select bug appears on the altitude scale. If the selected altitude is not within the scale in view, half of the bug appears at either the top or bottom of the scale to indicate whether a climb or descent is required to get to the preselected altitude. Single chevrons denote 500-foot increments on the scale, with double chevrons indicating 1,000-foot altitude increments.







When the aircraft is within 1,000 feet of the preselected altitude, the altitude preselect box above the altitude scale and the numbers inside the box turn amber.

If the climb rate is more than 1,000 feet per minute, the rolling drum digits turn to two dashes to enhance altitude scale readability.

Figure 16-19. PFD Altitude Display (Sheet 2 of 3)

- ***Altitude Select Bug***—The cyan (blue) altitude select bug travels along the left side of the altitude tape. The altitude select bug is notched to fit the 1,000- or 500-foot altitude tape chevron format (Figure 16-19, Sheet 3). The bug appears on the scale across from the altitude value set in the altitude alert select display. If the bug is moved off the current scale range, half of the bug remains on the scale to indicate the direction to the set bug (Figure 16-19, Sheet 2).
- ***Low Altitude Awareness***—At radio altitudes of 550 feet or less, the lower part of the altitude tape linearly changes from a gray raster to brown and the altimeter scale markings are removed. At zero radio altitude, the brown raster touches the altimeter reference line (see Figure 16-19, Sheet 1).
- ***Barometric Altimeter Setting***—The baro set window is directly below the altitude tape (Figure 16-19, Sheet 1). The pilot has the ability to set the altimeter in either inches of mercury (in. HG) or hectopascals (HPa) as selected with the PFD bezel controller (see Figure 16-4). If the on-side display controller is invalid, the SG defaults to the last selection (IN or HPa). The baro set data is always cyan (blue).
- ***Altitude Trend Vector***—The magenta altitude trend vector is displayed on the left edge of the altitude tape and provides an indication of the rate of altitude change (see Figure 16-19, Sheet 1). The trend vector extends vertically from the apex of the current altitude display window. The vector extends up for positive vertical trends and down for negative values. The vector represents a prediction of what the altitude can be in 10 seconds if the current vertical speed is maintained. The MADC outputs altitude rate of change.
- ***Standby Altitude***—Standby altitude indications are always available from the standby airspeed indicator/altimeter, which is discussed later in this chapter under Emergency Flight Instruments.

Vertical Speed Display

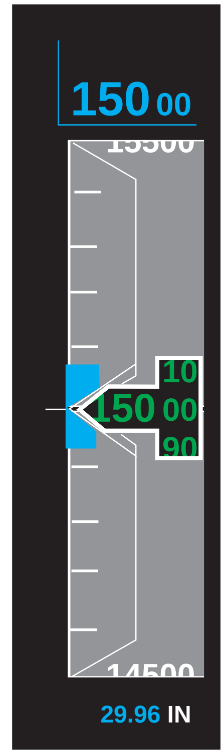
The vertical speed display is to the right of the EHSI and directly below the altitude display (Figure 16-20, Sheet 1).

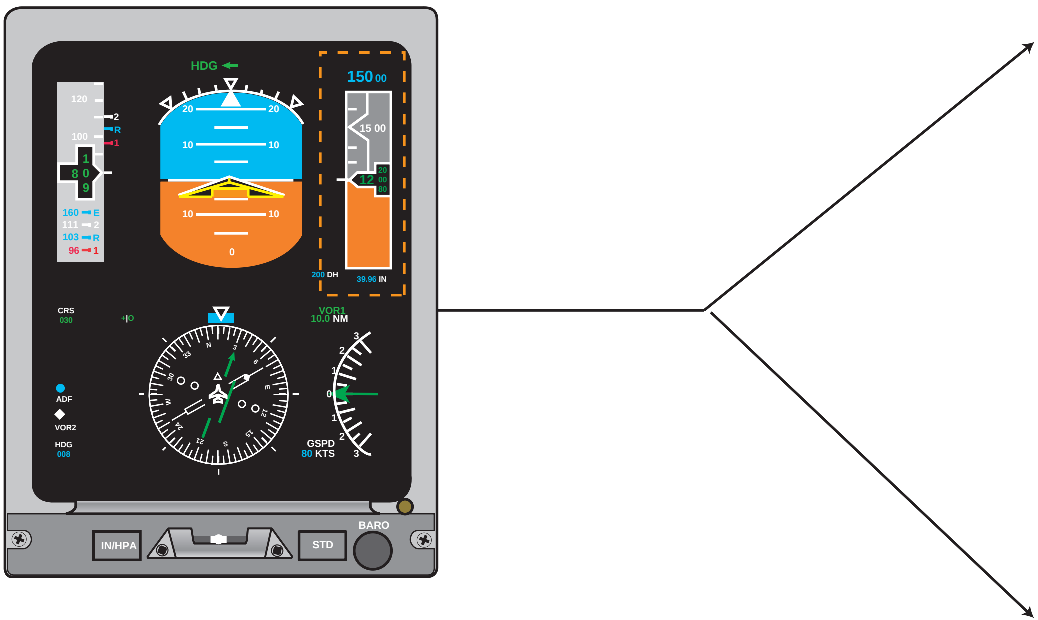
Vertical speed data is developed in the micro air data computers, which sense the rate of change of altitude from inputs of the static system. The computers convert the data into digital form and transmit it through the digital data bus system to the IC-600 display guidance computers, which forward it to the DU-870 primary flight displays (PFDs), where it is generated into a visual display.

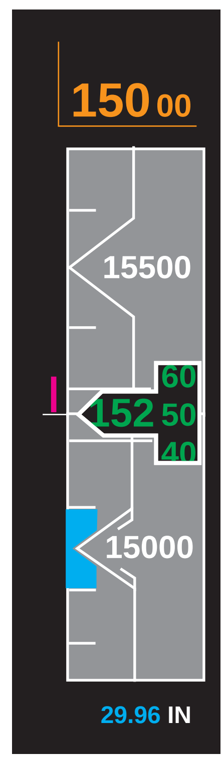
- ***VS (Vertical Speed) Analog Scale***—The VS scale is a fixed scale with moving pointer. The scale on the display ranges from +3,500 to –3,500 feet per minute. Display scale markings are 0, 1, 2, and 3. The scale and its marking are white (Figure 16-20, Sheet 1).
- ***VS Digital Display***—A digital display of the actual VS value is in a box, on the zero reference line. This data is a magnification of the digits on the scale and readable to a 50-foot-per-minute resolution. The digits within the box are green. Maximum value is 9,900 feet per minute. For values between ±500 feet per minute, the digital display is removed (Figure 16-20, Sheet 1). At values beyond ±500 feet per minute the digital value of vertical speed is displayed (Figure 16-20, Sheet 1).

  For vertical speeds greater than ±3,500 feet per minute, the pointer is positioned in the appropriate direction at the end of the scale. The digital display shows the actual vertical speed value (Figure 16-20, Sheet 2).
- ***Flight Director VS Target Display and Bug***—Engaging the vertical speed mode brings the VS target bug into view. The VS target bug moves along the right side of the VS scale (Figure 16-20, Sheet 2). The bug lines up with the value on the VS scale that is set with the autopilot controller pitch wheel or TCS button. The bug is always cyan (blue).

When the aircraft captures the altitude, the altitude preselect box and the numbers inside the box turn back to cyan (blue).







Once the aircraft has captured the altitude, if there is a deviation from the preselected altitude of 250 feet or more, the altitude preselect box and the numbers inside it again turn amber.

Figure 16-19. PFD Altitude Display (Sheet 3 of 3)

The digital readout of the target is displayed on top of this vertical speed scale. The target comes from the flight guidance system (Figure 16-20, Sheet 2).

- ***TCAS II Resolution Advisory Display (Option)***—The TCAS II system displays a green fly to target and a red do-not-fly band on the vertical speed display that commands the pilot to comply with a resolution advisory (RA) to avoid a potential aircraft conflict.
- ***TCAS Status Message***—The TCAS status messages are presented to the top left of the vertical speed display. When a TCAS II RA is displayed, the vertical speed digital display notches the color of the red or green band where the pointer is located.

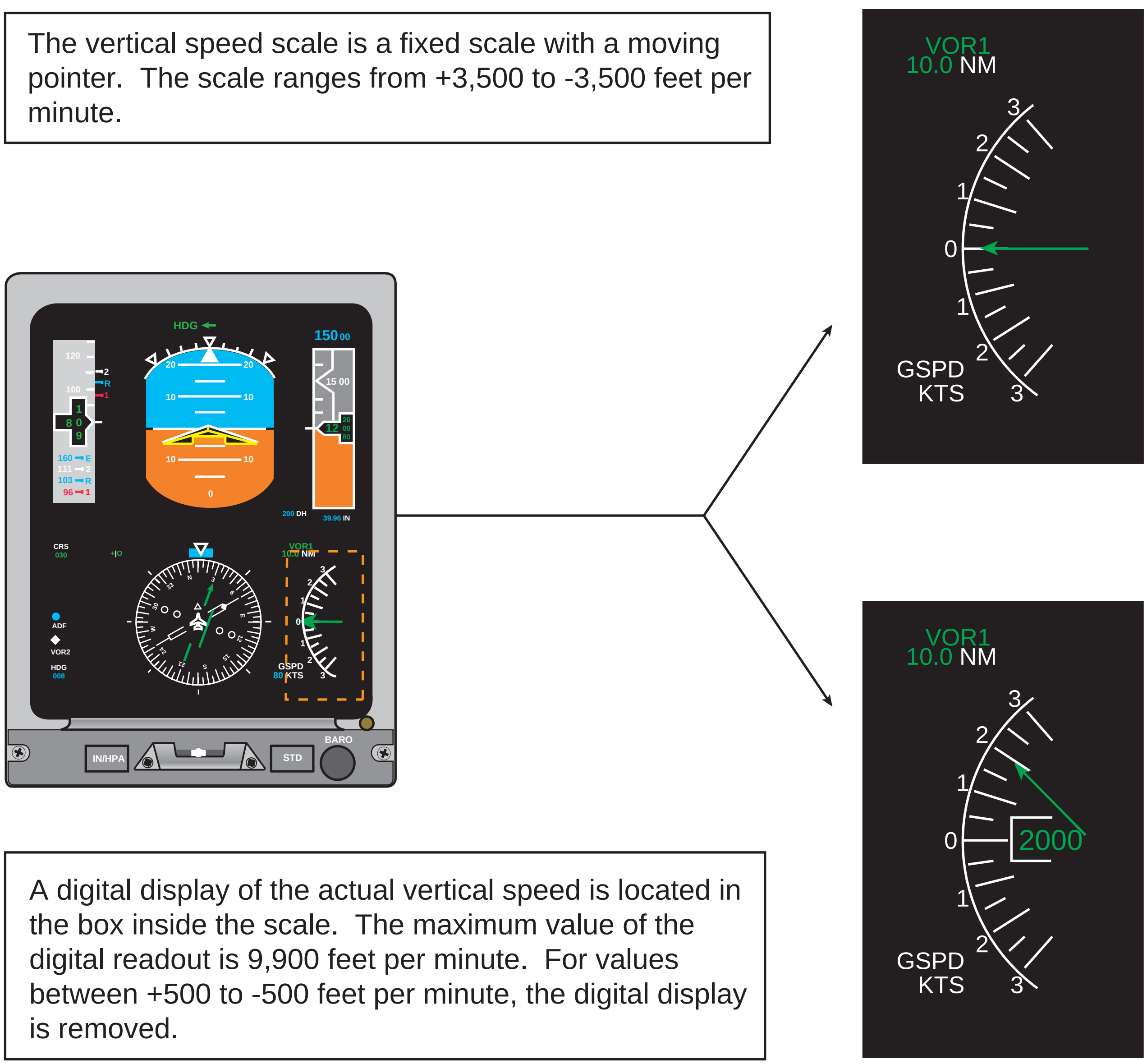


Figure 16-20. PFD Vertical Speed Display (Sheet 1 of 2)

Multifunction Display System

The multifunction display (MFD), the center cathode ray tube, serves as the weather radar indicator (Figure 16-21). It can be used to display the horizontal navigation situation, either short range (VORTAC) or long range (FMS), and to display electronic checklists. It also provides backup capability to the EFIS systems. If a symbol generator on one side fails, the pilot can, through the MFD controller, select the opposite-side symbol generator to take over the failed side display, and operation of the EFIS in that position continues as before,

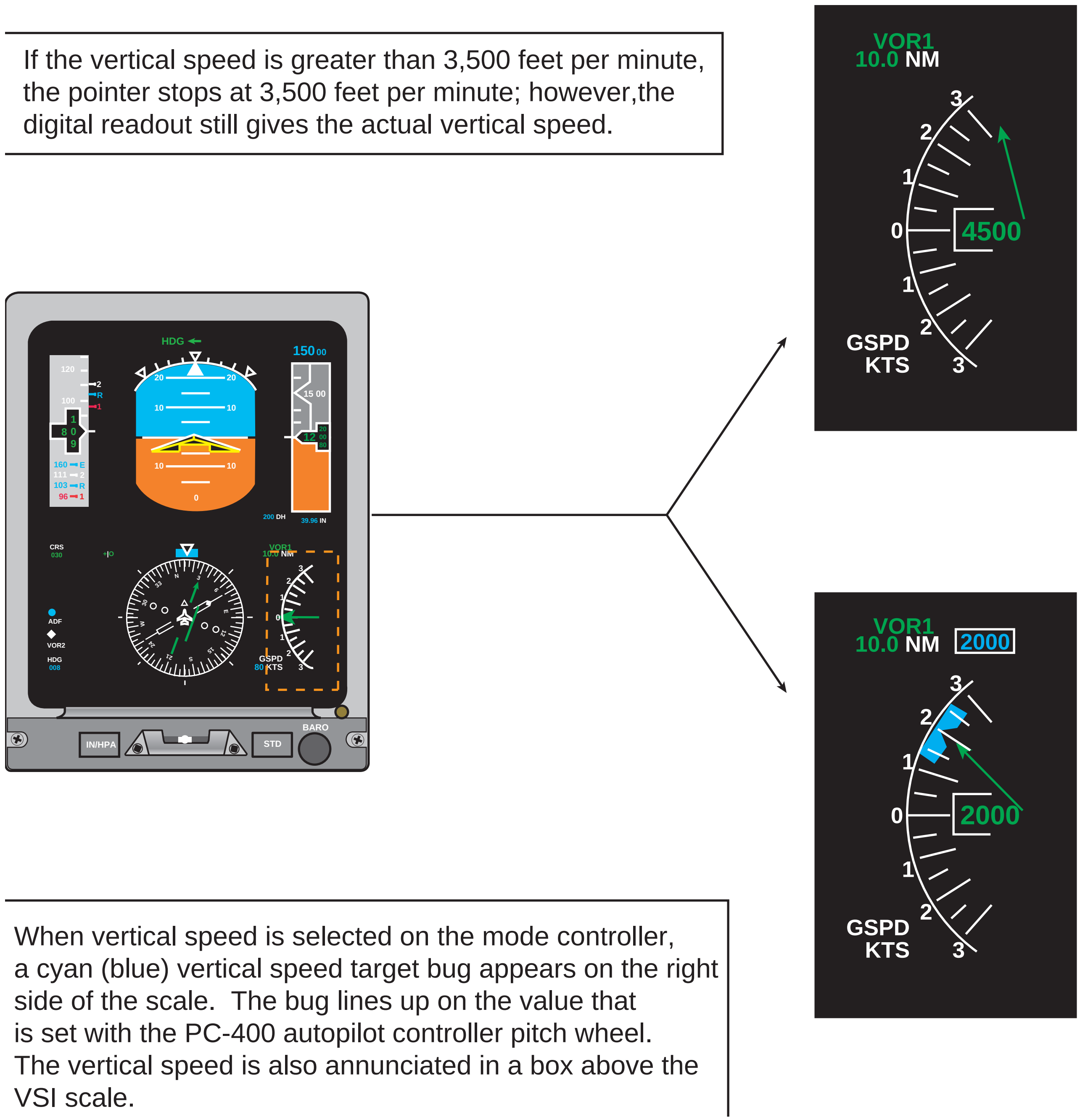


Figure 16-20. PFD Vertical Speed Display (Sheet 2 of 2)

with the selected symbol generator powering all three displays.

The multifunction display system expands on the navigation mapping capability of the EFIS, especially in conjunction with the flight management system (FMS). The MFD display may be used independently for navigation and mapping information without disturbing the EHSIs, which then may be used without additional displays which would result in more clutter on the EHSI. The weather radar display may be selected independently (by selecting OFF all of the navigation functions) or overlaid on the navigation display provided by the flight management system, in order to show the aircraft route with respect to the displayed weather returns.

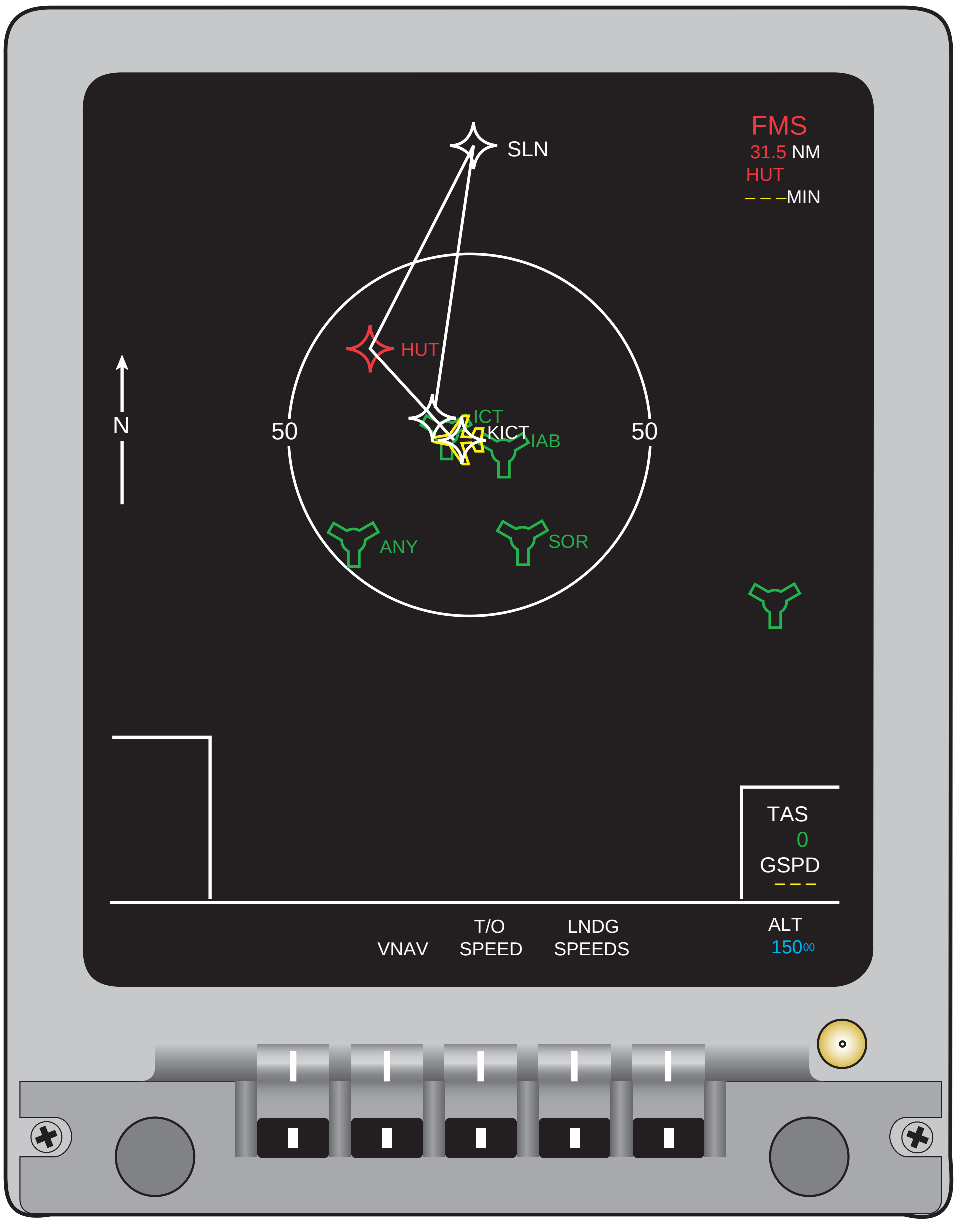


Figure 16-21. MFD Weather Radar Indicator (North UP—Plan Mode)

Multifunction Display Controller

The MFD controller (Figure 16-22), at the front of the pilot pedestal, allows mode selections, display control, and symbol generator reversion control of the pilot and copilot systems. In addition to its navigation, reversion, and checklist functions the MFD control also provides for control of the display of the optional traffic alert and collision avoidance system (TCAS).

Figure 16-22. MFD Controller

MFD Modes of Operation

The modes of operation available to the MFD system are listed as follows.

MAP Mode

The MAP function is a partial-arc, heading-up display which is selected by the alternate-action MAP/PLAN pushbutton. The MFD display cycles from MAP to PLAN as the MAP/PLAN button is pressed. The MAP format allows totally independent use of the MFD display for navigation mapping and allows increasing the maximum range, beyond normal radar range, on the display which normally serves as the radar indicator. Power-up mode is the MAP mode. To add weather to the display, press the WX button on the MFD controller.

The MAP format is always oriented to the aircraft heading, and the aircraft symbol is at the center of the display. When coupled to the FMS, the NAV route, with up to ten waypoints, can be displayed to the range limit. When weather returns are selected, range control defaults to the weather radar controller.

PLAN Mode

In PLAN mode, the top of the display is oriented to True North; a three-inch range is displayed and centered horizontally on the displayed area (see Figure 16-21). An aircraft symbol is plotted at present position (if present position is on the display) and is oriented with respect to heading. The PLAN mode display encompasses 360°. Weather radar returns cannot be presented in the PLAN mode.

TCAS (Traffic Alert and Collision Avoidance System) mode, the TCAS button is optional and its button selects TCAS traffic display on the MFD display.

Weather (WX) Mode

The WX mode allows the MFD display to be used as a weather radar indicator. In WX mode, weather data is presented on the MFD and is superimposed upon the normal navigation display. Weather radar can be selected for display on the MFD only if MAP mode is selected. If the MFD is in PLAN mode, selection of WX mode forces the display into MAP mode. Range selection is controlled by the weather radar control on the pilot instrument panel (Figure 16-23). When the WX button is toggled, the progression of selection is: WX on, WX off. Annunciation of weather modes, warnings, and antenna angle are provided at the lower middle left of the MFD display. Annunciations are color-coded in magenta, green, and amber according to the importance of the display. Operation of the weather radar is discussed later in this chapter.

Checklist Modes

The NORM button on the controller provides a display of flight plan waypoints or entry into the normal checklist display function. The normal checklists are arranged in the order of standard flight operations. Button actuations cause presentation of the normal checklist index page that contains the lowest order incomplete and unskipped checklist with the active selection at that checklist.

The RCL, SKP, PAG, and ENT buttons and the joystick provide control of this function and are discussed under MFD Controls below.

The EMER button on the controller provides entry into the emergency checklist display function. Actuation of EMER results in the presentation of the first page of the emergency checklist index with the active selection at the first checklist. The RCL, SKP, PAG, and ENT buttons and the joystick provide control of this function and are described in MFD Controls below. These controls perform as described for NORM with the exception of the action taken upon completion of the checklist. All checklist items are removed from the page, and EMERGENCY PROCEDURE COMPLETE is written below the amber checklist title. This is cleared when the index is selected. The SKP, PAG, and ENT buttons can be inoperative.

EFIS Backup Modes

In case of a symbol generator failure, the side having the failure may be selected to the good opposite side SG. If SG1 is selected (see Figure 16-22), the pilot symbol generator is driving all three PFD displays. SG2 means the copilot symbol generator is driving all three PFD displays. In these cases the MFD is normal, and both PFD displays have the same format. The multifunction display has no complete symbol generator function of its own.

Traffic Collision Avoidance System (TCAS) (Optional)

The TCAS mode allows the TCAS window to be displayed when TCAS is installed in the aircraft. The TCAS resolution advisory is displayed on the PFD (if TCAS II is installed), and traffic advisories are displayed on the MFD (see Figure 16-23).

MFD Controls

Dim—This knob controls overall MFD CRT dimming in addition to the automatic dimming feature accomplished by CRT-mounted photodiodes. Turning the knob counterclockwise dims the display. The WX display is dimmed at the same time.

Joystick—The function of the joystick depends upon the type of MFD display:

- ***MAP or PLAN***—Moves the designator in directions shown.
- ***TEXT***—Vertical actuations—Acts as a cursor control by changing the active line. This provides an additional means of skipping lines or returning to a previously skipped line.

Figure 16-23. Weather Radar Controller

- ***Horizontal Actuations*****—**Controls paging. Actuation to the right increases the page number, and actuation to the left decreases the page number.

MAP/PLAN**—**Pressing the MAP/PLAN button selects the MAP MFD display mode. Pressing it again selects north-up PLAN mode.

WX**—**Weather radar data may be displayed with the MAP mode. The toggling sequence of this button is: WX on, WX off. If PLAN mode is selected, selection of MAP mode can be forced when WX mode is selected.

VOR**—**This button is used to display the four closest VORs, that are not on the active flight plan list, on the MFD MAP and PLAN displays.

APT**—**The APT button is used to display the four closest airports, that are not on the active flight plan list, on the MFD MAP and PLAN displays.

DAT**—**This button is used to add long-range NAV information to the MFD MAP and PLAN displays.

Range controls (INC and DEC)—The MFD range controls are active only when WX is not selected display. Selectable ranges are 5, 10, 25, 50, 100, 200, 300, 600, and 1200 NM. The INC switch position increases the selected range, and the DEC position decreases the selected range.

NORM**—**When this button is pressed, the MFD displays the index page containing the lowest numbered incompleted or unskipped checklist with the active line at that checklist. All waypoints of the current flight plan may be displayed.

While operating in this mode, as a checklist is completed, the system automatically steps to the next incompleted procedure of the index.

EMER**—**Actuation results in the display of the first page of the emergency checklist index.

RCL**—**The function of this button depends upon the type of MFD display:

- ***MAP or PLAN*****—**Recalls the designator to its home position.
- ***TEXT*****—**Recalls the lowest numbered skipped line in a checklist by changing the active page and/or line.

SKP**—**The function of this button depends upon the type of MFD display:

- ***MAP or PLAN*****—**Skips the designator to the next waypoint. If the designator is not at the home position, the displacement line is moved to the next waypoint.
- ***TEXT*****—**Actuation skips the active line in a checklist or index and advances the active selection to the subsequent line. If the line skipped is the last line, the active selection reverts to the lowest numbered skipped line.

PAG**—**Actuation advances the page count and places the active line selection at the first line of the page. Actuation with the last page displayed results in display of the lowest numbered page containing a skipped line with the active line selection at the lowest numbered skipped line.

ENT**—**The function of this button depends upon the type of MFD display:

- ***MAP or PLAN*****—**With the designator moved from its home position, actuation of these buttons enters the designator LAT/LOG as a waypoint in place of the TO waypoint.
- ***TEXT*****—**Actuation checks off a line in a checklist or selects an index line item for display.

Auxiliary EFIS Annunciators

Indications are in the upper left of the multifunction display.

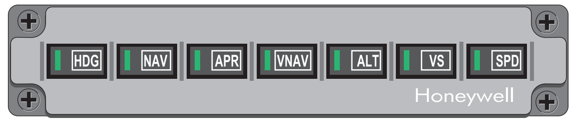
- ***IC-1 HOT*****—**Indicates overtemperature condition of pilot IC-600 display guidance computer.

- ***IC-2 HOT*—**Indicates overtemperature condition of copilot IC-600 display guidance computer.
- ***IC-1-2 HOT*—**Indicates overtemperature condition of both IC-600 display guidance computers.
- ***IC-1 FAN*—**Indicates failure of pilot IC-600 cooling fan.
- ***IC-2 FAN*—**Indicates failure of copilot IC-600 cooling fan.
- ***IC-1-2 FAN*—**Indicates failure of both IC-600 cooling fans.
- ***CHK PFD1*—**IC-600 display guidance computer detects a wraparound failure in PFD 1. Data displayed is not being updated. Verify critical data with other flight instruments. Comparator warnings may not be active.
- ***CHK PFD2*—**IC-600 display guidance computer detects a wraparound failure in PFD 2.Data displayed is not being updated. Verify critical data with other flight instruments. Comparator warnings may not be active.
- ***CHK PFD1-2*—**IC-600 display guidance computers detect a wraparound failure in both PFDs. Data displayed is not being updated. Verify critical data with other flight instruments. Comparator warnings may not be active.

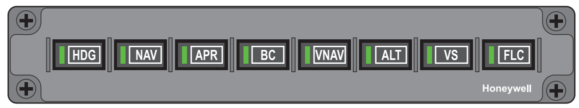
Flight Director Mode Selector

For SNs 0260 through 0401 the flight director mode selector consists of seven push-on, push-off switches. For SNs 0401 and on, the flight director mode selector consist of eight push-on, push-off switches, which include a BC push-on, push-off switch (Figure 16-24). The push-on, push-off switches allow the pilot to select various flight director/autopilot modes of operation. The green mode activation light in the switch (button) is illuminated if the corresponding mode is in the arm or capture state.

The status of the selected mode is displayed in white letters (annunciations) in the primary



PHASE 2 CONTROLLER
SNs 0260 THROUGH 0400



PHASE 3 & 4 CONTROLLER
SNs 0401 AND ON

Figure 16-24. Flight Director Mode Selector

flight display (PFD) when armed, and in green when capture has occurred.

The flight director can be selected off by deselecting all of the modes on the flight director mode selector. The command bars will bias out of view. If single-cue flight director operations is selected on the DC-550 display controller, the flight director/autopilot can not engage if only a vertical mode is selected. If no modes are selected on the flight director mode selector, the autopilot engages in a basic heading-hold/pitch-hold mode.

Operation of the various modes is explained later under Primus® 1000, Flight Director Modes. The pilot and copilot may select either NAV 1 or NAV 2 for display on their respective PFD by means of the NAV button on the display controller. The respective on-side NAV is automatically selected upon power-up. If both sides have been selected to the same source, the annunciation of VOR 1, etc., in the PFD is in yellow. The selection of NAV 1, NAV 2, or FMS is annunciated in the upper right corner of the PFD as VOR 1, VOR 2, and FMS respectively.

The selection of NAV 1, NAV 2, or FMS on the display controller pushbuttons controls the source of navigation information to the flight director, as well as selects the source of navigation information displayed on the EHSI course deviation indicator (CDI) of the PFD.

A switch (AP XFER FD1/AP XFER FD2), to the right side of the MFD, is installed to determine which flight director controls the autopilot (Figure 16-25). The position of this switch can be changed with the autopilot engaged or disengaged, however, the Flight director modes drop out and the autopilot reverts to basic modes if engaged.

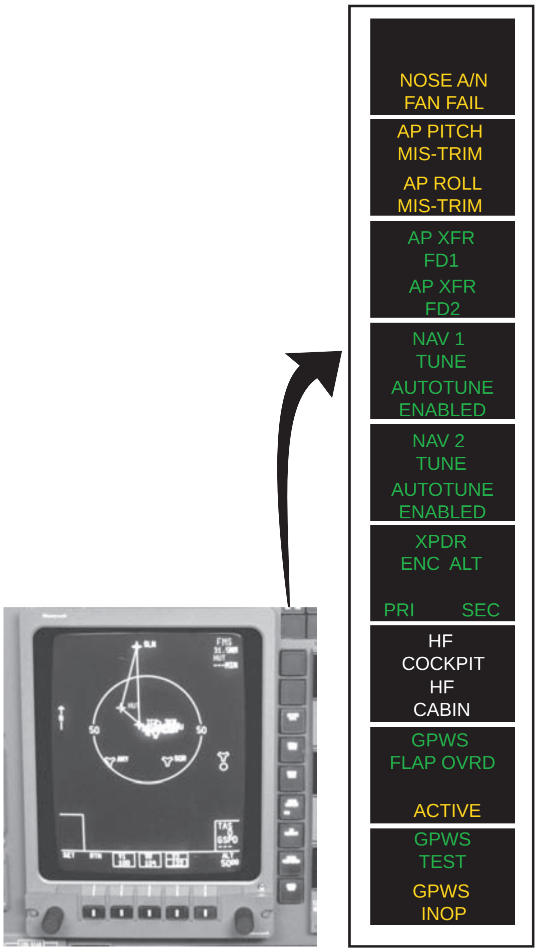


Figure 16-25. MFD Annunciator Strip Lights

AUTOPILOT CONTROL PANEL

The autopilot control panel, mounted on the pedestal, provides the means of engaging the autopilot and yaw damper, as well as manually controlling the autopilot through the turn knob and pitch wheel (Figure 16-26).

Figure 16-26. Autopilot Control Panel

The autopilot (AP) engage switch is used to engage the autopilot and yaw damper. The yaw damper (YD) switch is used to engage and disengage the yaw damper without the autopilot. Use of the yaw damper while manually controlling the aircraft aids in aircraft stability and passenger comfort. The push-on/push-off AP and YD switches are illuminated green when engaged. Pressing the AP switch when the autopilot is engaged disengages the autopilot but leaves the yaw damper engaged. Pressing the YD switch when both yaw damper and autopilot are engaged turns off both the yaw damper and the autopilot. The yaw damper and autopilot may also be disengaged with the red AP TRIM DISC button on the pilot and copilot control wheels (Figure 16-27). Pressing the go-around (GA) button on either throttle (Figure 16-28), disconnects the autopilot and forces the flight director into the go-around mode; the yaw damper remains engaged.

The pitch wheel allows manual pitch control of the aircraft proportional to the rotation of the wheel and in the direction of wheel movement. Movement of the wheel also cancels any other previously selected vertical mode. The turn knob allows manual bank control of the aircraft proportional to and in the direction of knob movement. Turns with a maximum bank angle of 30° can be performed with the turn knob. The turn knob must be in the center detent position before the autopilot can be engaged. Rotation of the turn knob out of detent cancels any other previously selected lateral mode.

The elevator trim indicator shows an out-of-trim condition, in the direction indicated by

Figure 16-27. Autopilot TRIM DISC and TCS Buttons

Figure 16-28. Autopilot Go-Around (GA) Button

illumination of UP or DN in the TRIM annunciator, when a sustained trim input is being applied to the elevator servo. The indicator should be OFF before engaging the autopilot. If the TRIM annunciator is illuminated and the autopilot must be disengaged, the pilot should be prepared for an out-of-trim condition in the annunciated direction. A separate additional AP PITCH MIS-TRIM/AP ROLL MIS-TRIM annunciator is on the center instrument panel, where it is more readily visible to the pilots (see Figure 16-25). The AP PITCH MIS-TRIM annunciator is a repeat of the TRIM annunciator on the autopilot control panel.

The AP ROLL MIS-TRIM annunciator indicates to the pilot that a sufficient level of roll mistrim is present and the pilot must be prepared for an out-of-trim roll condition if the autopilot is disconnected. The bank limit (LOW) mode may be selected if it is desired to limit the maximum bank angle during autopilot operation. The mode is limited to use in conjunction with heading ( ) mode only. When the bank limit mode is engaged, the autopilot maximum bank angle is limited to 14°. When the mode is engaged, LOW annunciates in the pushbutton. Low bank mode is automatically selected when climbing through 34,000 feet altitude,and automatically canceled when descending through 33,750 feet. If heading mode is selected and then deselected while low bank is engaged, low bank mode is disengaged and the engage light extinguishes during the time heading mode is disengaged, but low bank mode reengages and the LOW annunciator reilluminates when heading mode is reengaged.

The autopilot is normally disengaged in one of three ways: (1) depressing the AP TRIM DISC switch on either yoke, (2) electrically trimming the elevator trim system, or (3) depressing the go-around button on either throttle. Actuation of the touch control steering button interrupts the pitch and roll servos until the switch is released; the yaw damper remains engaged. If the autopilot is disengaged by any of the above three ways, a warning tone sounds for one second, and the amber AUTOPILOT OFF light illuminates for one second. Any other disconnect causes the warning horn to sound for one second and the AUTOPILOT OFF light to stay illuminated. The amber light can be turned off by holding the AP TRIM DISC switch for two seconds, or by pressing the electric trim switch or the go-around (GA) button on either throttle. The autopilot also disengages if an overriding force (sustained torque) is applied to the vertical or horizontal axis for a minimum preset time. Disconnect is annunciated by the one-second disconnect tone and illumination of the autopilot disconnect light until the light is extinguished by one of the above methods.

PRIMUS® 1000 INTEGRATED OPERATION (EFIS/FLIGHT DIRECTOR/AUTOPILOT)

The Primus® 1000 system in the Citation V ULTRA operates through displays of the pilot (or copilot) electronic flight instrument system (EFIS). The systems of autopilot and EFIS are integrated, and unnecessary system redundancy has been eliminated. The result is an overall simplification over previous systems and greatly simplified interface requirements for the flight director function. If a particular EFIS unit is operational, the flight director will also be operational, and conversely if the EFIS has failed, the flight director will also be failed. The display is available as a single-cue or a double-cue (cross pointer) presentation, the selection of which is made by means of the SC/CP button on the display controller (see Figure 16-10). The presentation upon power-up is single-cue. Glide-slope and VNAV vertical path information are presented on the right side of the electronic attitude director indicator (EADI) section of the PFD. The pertinent command bar(s) of the flight director can be brought into view, when double-cue display is selected, by selecting any mode. If single-cue mode is selected, selection of only a vertical mode will not bring the command bars into view.

The autopilot may be switched to the pilot flight director (FD 1) or the copilot flight director (FD 2) by means of an illuminated selector switch (AP XFER FD 1/AP XFER FD 2) on the center instrument panel (see Figure 16-25). This switch determines only which flight director system provides guidance to the autopilot.

The Primus® 1000 system incorporates a wide variety of capabilities that produces one of the most precise, flexible, and easy-to-use systems in aircraft today. The flight director and autopilot can be used independently or together. The aircraft may be flown manually, using the guidance provided by the modes selected on the flight director, or when the autopilot is engaged and coupled to the flight director, it controls the aircraft using the commands generated by the flight director computer. Disengagement of the autopilot has no effect on the FD modes in operation at the moment of disengagement, except when using the go-around button, in which case a wings-level 10° noseup attitude is commanded and all other FD modes are reset. When the autopilot is engaged without any mode selected, manual pitch and roll commands may be made by means of the turn knob and pitch wheel on the autopilot controller. Touch control steering (TCS) can be used to maneuver the aircraft or to modify the commands to the FD and AP. If the autopilot is not engaged, the TCS button can be used to synchronize the command bars to the aircraft attitude. If HDG mode has been selected, BANK LIMIT mode may be engaged, and the maximum bank angle is limited to approximately 14°.

Basic Autopilot

The basic autopilot, without any inputs from the flight director system, can be used for pitch, roll, and heading hold. The autopilot holds the pitch attitude existing at the moment of AP engagement and the pitch attitude existing at the moment of disengagement of a vertical mode.

The autopilot can be engaged in any reasonable attitude; however, unless touch control steering (TCS) is used in conjunction with autopilot engagement, the autopilot rolls wings level if engaged while in a bank. If the bank is less than 6° at engagement, the autopilot holds the heading indicated when the autopilot is engaged. If the bank is over 6° at engagement, it holds the heading indicated when the aircraft rolls through 6° of bank on the way to wings level. If a lateral mode is disengaged, the autopilot holds the heading existing at the moment of disengagement. If the turn controller is out of the center detent position, the autopilot will not engage (annunciated in amber on the PFDs).

Touch Control Steering (TCS)

Touch control steering (TCS) (see Figure 16-27) enables the aircraft to be maneuvered manually during autopilot operation without cancellation of any selected flight director

modes. To use touch control steering, press the TCS button, maneuver the aircraft, and release the TCS button. TCS is operable with all autopilot modes. During TCS operation the yaw damper remains engaged.

If the autopilot is engaged in a bank and it is desired to hold the bank, press the TCS button, engage the autopilot, and release the TCS button. The bank is maintained if it is in excess of 6°. The aircraft may be rolled level with the turn knob. The memory function holding the autopilot in a bank is canceled when the knob is moved out of detent.

In the case of speed (SPD/FLC) (IAS or MACH annunciated) mode, vertical speed (VS) mode, or altitude hold (ALT) mode, the TCS button may be depressed and the aircraft maneuvered to a new reference. When the TCS button is released, the flight director/autopilot maintains the new reference.

Pitch Synchronization

When flying the aircraft manually and using the flight director, the command bar may be matched to the existing pitch attitude by pressing the TCS button (command bar assumes a neutral position) and releasing it; the command bar synchronizes to the aircraft attitude at the moment of release.

Flight Director Modes

Heading

The heading mode (HDG—annunciated in green letters in the top right of the EADI) can be used with the flight director (FD) only, or in conjunction with the autopilot. When the heading (HDG) mode is selected on the FD mode selector (see Figure 16-24), the command bars come into view and display a steering command that is controlled by the HDG cursor (bug) on the remote instrument controller (see Figure 16-16) on the PFD. The command bars synchronize vertically to the pitch attitude at the time of HDG selection. Heading mode is engaged automatically if another lateral mode is selected and the aircraft is outside the capture parameters of that mode. In this case, HDG mode remains ON until the aircraft arrives at a point where capture can occur. The selected mode then captures and is annunciated in the mode selector and in green letters at the top left side of the PFD/EADI, and HDG cancels. If the autopilot is also engaged, the autopilot receives steering commands according to the selected mode(s). NAV and APR modes can be armed with the HDG mode ON. When intercepting a VOR radial or localizer course with the NAV or APR modes selected, the system switches from ARM to CAP when within the capture limits and the armed mode is captured.

VOR (NAV) and VOR APR (APR)

Two different modes of capture and tracking a VOR signal are used on the Primus® 1000 system. One method is used for normal enroute navigation (NAV) and the other for a VOR approach (APR).

For enroute navigation, the desired VOR frequency is selected on a NAV receiver, the course bearing set on the EHSI using the remote instrument controller (see Figure 16-16), and NAV mode is selected on the flight director mode selector. The small green light in the mode selector illuminates, and if the aircraft is outside the NAV capture limits, VOR is annunciated in white at the top left of the EADI, and HDG is annunciated in green directly to the right of the white VOR. As the aircraft is maneuvered within the capture limits, HDG extinguishes and VOR illuminates in green. When the mode is transitioning to capture, a white box is drawn around VOR for five seconds.

For a VOR approach (APR mode), the desired VOR frequency is selected on the NAV receiver, the course bearing is set on the EHSI, and the APR mode is selected on the flight director mode selector. The green light illuminates in the APR button, and if outside the capture limits, V_{APP} illuminates in white on the top left side of the EADI. HDG annunciates in green next to V_{APP}. When the aircraft maneuvers into capture range, HDG mode cancels and V_{APP} annunciates in green in the

top left side of the EADI. A white box is drawn around the capturing V_{APP} for five seconds.

In both NAV and APR modes, a station passage feature incorporates bank angle limits and a course hold (plus wind drift) mode. The station passage mode for enroute tracking (NAV mode) is of long enough duration to provide smooth transition of a VOR station at any altitude. The station passage mode for APR mode is of short duration to provide approach accuracy. This does not provide the degree of ride smoothing that is present in the enroute case.

ILS Approach (LOC or LOC GS)

With a localizer frequency selected in a NAV receiver, operation is similar to capturing and tracking a VOR radial. Selecting APR on the mode control panel with a localizer frequency tuned arms both the LOC and GS modes and engages HDG, if not previously selected and the aircraft is outside the capture parameters of the mode. It is imperative that the APR button be pressed when the aircraft is within less than 90° of the final approach course of the published ILS course; otherwise, the system assumes that a back course is being selected and so annunciates. HDG is displayed in green at the top left of the EADI, the green light in the APR button of the mode selector illuminates, and LOC and GS are illuminated in white on the upper left and right, respectively, of the EADI. When inside the LOC capture limits, LOC illuminates in green at the top left of the EADI, and HDG extinguishes. At glide-slope capture (approximately 1/2 dot), GS illuminates in green on the EADI. During transition to both the LOC and GS capture modes, a white box will be drawn around the respective mode annunciations. During ILS approaches, the FD gain is progressively adjusted during the approach using GS deviation, radio altitude, and middle marker passage for gain programming. If the radio altimeter is not operational, this function is performed as a function of glide-slope capture and middle marker passage.

The capture limits for VOR and LOC captures are variable depending on DME distance, speed, and intercept angle. Glide-slope capture is locked out until localizer capture occurs. If the localizer mode becomes invalid for any reason, the glide-slope mode is also canceled.

The glide-slope indicator, on the right side of the EADI presentation, is green unless there is a cross-side selection, in which case it is yellow.

Back-Course Localizer Approach (BC)

Phase 2 (Without BC Button)

A back-course localizer approach capability is provided using either flight director or autopilot or both.

With a localizer frequency set in the selected NAV, selecting APR on the mode selector arms the system for a back-course localizer approach. The front course of the ILS must be set into the EHSI to give proper indications on the course deviation bar and for the flight director computer to compute correct back-course corrections during the approach. If the back course is set on the EHSI, the command bars and autopilot are given incorrect steering commands. When APR is selected on the mode selector, the green light in the button illuminates and BC is annunciated in white on the left top side of the EADI. HDG may illuminate in green if the aircraft is outside of back-course capture parameters. It is imperative that the APR button be pressed when the aircraft is within less than 75° of the final approach course of the published back course; otherwise, the system assumes that a front course is being selected and so annunciates. When the back course is captured, BC is illuminated in green on the top left side of the EADI, HDG extinguishes if heading mode was engaged to accomplish intercept. The system will not annunciate the back-course mode until localizer capture occurs and the system confirms that the heading is in excess of 105°

from the selected (front) course.

Altitude Hold (ALT) and Altitude Preselect (ASEL)

Selecting altitude hold (ALT) provides steering commands to maintain the altitude at the moment of engagement. An altitude preselect (ASEL) mode provides a preprogramming capability. To use altitude preselect, the desired altitude is set into the ALT window at the lower right corner of the multifunction display (MFD) by means of the knob on the bottom right of the MFD bezel (see Figure 16-5). ASEL illuminates in white in the top right side of the EADI to indicate that the altitude preselect mode is armed. The aircraft may be maneuvered toward the desired altitude using any of several methods: the autopilot wheel, touch control steering, FD pitch sync, speed hold, or vertical speed hold. If the aircraft is flown manually, the flight director guides the pilot onto the selected altitude. As the aircraft approaches the desired altitude, the altitude preselect captures at an altitude corresponding to approximately 1/5 the rate of climb/descent; i.e., at 2,000 feet/minute climb rate, the system captures approximately 400 feet prior to the selected altitude.

At capture, the mode ASEL illuminates in green on the EADI. The flight director performs a smooth level-off at the selected altitude. At level-off altitude, ALT mode is automatically selected and displayed in green on the EADI, and ASEL disappears. Once altitude hold is captured, the touch control steering (TCS) button on the control wheel can be used to change or trim the selected altitude. TCS operates in conjunction with the flight director or the autopilot or both. Once ALT mode is engaged, resetting the BARO setting on the pilot altimeter causes the aircraft to climb or descend to recapture the same indicated altitude. Moving the autopilot pitch wheel causes ALT or ASEL CAP modes to be canceled if either is selected.

Selection of a vertical mode without a lateral mode provides autopilot tracking of the mode, but the FD command bars are not in view.

Airspeed Hold (SPD/FLC) and Vertical Speed Hold (VS)

Speed (SPD/FLC) hold (IAS or MACH—mode selectable depends upon altitude) and vertical speed (VS) hold are selected by pressing the appropriate mode button (SPD/FLC or VS) on the flight director mode control selector. The flight director, autopilot, or both hold the airspeed (Mach if appropriate) or vertical speed indicated at the moment of engagement. The green light in the respective mode selector button illuminates and VS or IAS (or Mach), as appropriate, illuminates in green on the EADI. When initially selecting speed mode, the speed target synchronizes to the existing indicated airspeed for altitudes below 28,900 feet and synchronizes to the existing Mach number for altitudes above 28,700 feet. The target automatically switches from indicated airspeed to Mach number as the aircraft climbs through 28,900 feet. It automatically switches from Mach number to indicated airspeed as the aircraft descends through 28,700 feet. Upon initially selecting vertical speed hold mode, the vertical speed synchronizes to the existing vertical speed. Once the vertical speed mode is selected, the pilot can select a different vertical speed with the pitch wheel on the autopilot controller. If the autopilot is engaged after VS mode is selected, the vertical speed must be resynchronized.

The autopilot pitch wheel may be used to change the reference speeds for both the speed mode and the vertical speed mode. The touch control steering (TCS) button may also be used to temporarily release the autopilot clutches and maneuver the aircraft to a new reference. The airspeed, Mach, or vertical speed established when the (TCS) button is released becomes the new reference.

A lower limit of 120 KIAS is established, below which the SPD/FLC mode will not engage. At the opposite end of the speed spectrum, V_{MO} or M_{MO}, as appropriate, will not be exceeded. If an upper limiting speed is attained, the system maintains the limiting speed; thus speed hold can be used to fly V_{MO} or M_{MO} descents.

Selection of the speed-hold mode cancels all other vertical modes except vertical/navigation (VNAV), altitude preselect arm (ASEL—white annunciation) and glide-slope arm (GS—white annunciation).

Go-Around Mode

A go-around mode (GA) is available through buttons on the left and right outboard throttles (see Figure 16-28). Depressing one of the buttons drops all other FD modes and disconnects the autopilot except, for the yaw damper. The FD command bars will command a wings-level 10° noseup climb attitude. GA illuminates in green on the EADI. After go-around has been selected, the selection of any lateral mode cancels the wings-level roll command, but pitch-up command remains. The go-around mode is canceled by selecting another pitch mode, pressing the TCS button, or engaging the autopilot.

Vertical Navigation (VNAV)

The vertical navigation mode (VNAV) provides a means to define a climb or descent path to a vertical waypoint ahead of the aircraft and to track the path to that waypoint. The waypoint is defined based on a distance reference (bias distance) TO or FROM a short-range VORTAC station waypoint, or the next FMS waypoint if the FMS system is being used for navigation. Upon arrival at the waypoint/ altitude, the mode automatically changes to altitude select (ASEL) capture mode and then to altitude hold (ALT) mode when it levels at the selected altitude.

VNAV Definitions and Operation

- ***Desired Altitude (ALT)***—The altitude at which the aircraft levels at the completion of the climb or descent.
- ***Station Elevation (STA EL)***—The elevation above sea level of the VORTAC station that the VOR and DME are receiving. Does not apply to FMS waypoints when used for VNAV.
- ***TO/FROM Bias (TO/FR)***—The distance set into the VNAV that moves the point for completion of the problem away from the VORTAC or FMS waypoint being used. TO bias moves the point closer to the aircraft than the VORTAC or FMS waypoint being used. FROM bias moves the point farther from the aircraft than the VORTAC or FMS waypoint being used.

During VNAV operation overspeed protection based on the V_{MO} speed limit and underspeed protection based on a fixed 120-knot speed are provided. If either of these speeds is reached, a special submode engages and overrides the VNAV mode until the speed situation is corrected. If a deviation of 1,000 feet from the computed path occurs, VNAV mode cancels.

VNAV operation is canceled if another vertical mode is selected, the air data information from the micro air data computer (MADC) becomes invalid, the DME signal is lost for five seconds, an overspeed or underspeed as described above occurs, the PFD NAV source is changed, glide-slope capture or level-off at the waypoint occurs or in case of detection of various system faults by the system monitors.

In order for VNAV mode to operate, the aircraft must be proceeding along a direct path toward or away from the short-range NAV (VORTAC) (or to the next FMS NAV waypoint) which has been selected as a reference. If a VORTAC is being used, the VOR azimuth and DME must be locked onto the VORTAC station for VNAV computation. The desired altitude, station elevation (VORTAC only) to the nearest 100 feet, and the TO/FROM bias (if required) must be set into the VNAV system. If the FMS is being used for navigation, the next waypoint may be used, with or without TO or FROM bias, and station elevation (STA EL) data is not required. Attempts to insert VNAV problems behind the aircraft or outside the parameters of the system will be ignored by the system.

Programming

Programming is possible when a VOR station is tuned, lock-on of azimuth and DME occurs, and the waypoint desired is within selectable parameters, or when FMS navigation is in use and the next waypoint is used to define the VNAV problem. Arming of the VNAV to any waypoint consists of selection of the desired waypoint, and selection of waypoint data which will enable the flight director computer to compute a viable VNAV problem.

VNAV selections can be made using short-range NAV, when a VORTAC station is tuned, identified, and lock-on is achieved. Set the desired altitude in the preselect window. If TO or FROM (FR) bias is required, the second button from the left on the bezel of the multifunction display (MFD) is pressed (see Figure 16-9), which results in display of a box into which may be set the TO or FR bias by turning the left knob on the MFD. TO or FROM is selected before the distance selection is made by toggling the button, resulting in annunciation of TO or FR above the selection window. Station elevation (STA EL) of the VORTAC station in use is then set by pressing the second button from the right and setting the correct elevation, to the nearest 100 feet, into the window above it. The VNAV problem is now established, and VNAV may be selected. If long-range NAV is used, the problem is similarly defined; FMS must be selected on the display controller, which results in long-range data being displayed on the menu at the bottom of the MFD display, and therefore being selected by the respective knobs discussed above. If FMS is being used, station elevation (STA EL) is not required.

If a valid problem has been defined, the computed angle will be displayed on the MFD VNAV menu at the bottom right of the MFD display. A NAV problem is valid only if the vertical angle is less than ±6°. The flight director computer will continually compute the vertical angle based on aircraft position and update the display on the vertical path indicator on the PFD. If the pilot desires, he can rotate the VNAV set knob and increase the vertical angle up to a maximum of 6°, which creates a vertical path intercept point some distance ahead of the aircraft. Once a valid VNAV problem has been defined, the pilot can select the VNAV mode on the FD mode selector. VNAV mode will, however, not activate until it is selected, or selection is affirmed, by pilot action. Adjacent to the calculated VANG display is a vertical speed (VS) display. It is used for monitoring the climb or descent and cannot be set.

If the pilot has selected an intercept point ahead of the aircraft by increasing the vertical angle before selecting the VNAV mode, the flight director remains in the previous mode until the appropriate time. Approximately one minute prior to the flare point the altitude alert horn sounds two short beeps. The vertical track alert (VTA) on the PFD and the VNAV annunciator on the FD mode selector flash. Pilot action is required before the VNAV capture phase can commence. The pilot must press the flashing VNAV button on the mode selector before it stops flashing to allow the mode to capture. Once the button is pressed, the annunciation in the mode selector stops flashing and remains on, as with the VTA annunciator on the PFD. If the pilot wishes to cancel the mode, he can press the VNAV button twice on the mode selector when it flashes, or he can do nothing and wait for the flashing to stop, at which time the mode automatically disengages.

When the VNAV mode is engaged, the VNAV parameters are frozen. This includes STA EL, TO, FROM, and VANG; changing the ALT SEL value also causes the mode to drop out. The pilot may still view any of these parameters, but the set knob will have no affect. After the aircraft has leveled off at the waypoint altitude and transitioned into altitude-hold mode, the VNAV parameters for the current problem are erased.

If the pilot deselects the VNAV mode by pressing the VNAV button, the flight director cancels the mode, but the data for the current waypoint are retained. The angle from the present position to

the waypoint is still tracked, but the parameters are no longer frozen and can be modified as desired by the pilot. The VNAV mode can be reselected as long as the problem remains valid.

Altitude Alerting

The altitude alerting system is automatically engaged in conjunction with the altitude preselect mode (ASEL) and the vertical navigation (VNAV) mode. The desired altitude is set into the system for use of the VNAV or ASEL modes. In both cases the altitude is set into the lower right corner of the MFD with the right knob on the MFD bezel. The desired flight director mode which is to be used to reach the designated altitude is then selected on the flight director/autopilot mode control panel. Refer to Altitude Hold and Altitude Preselect, above. If the pilot does not desire to select a flight director mode, the aircraft can be flown manually, and the altitude alerting system will still provide the appropriate annunciations.

Mode Annunciations

Flight director vertical and lateral modes are annunciated along the top of the PFD. Armed modes are annunciated in white slightly to the left of the captured vertical and lateral mode annunciations, which are displayed in green. Lateral modes are displayed to the left of top center and vertical modes displayed to the right of top center on the PFDs. A white box appears around a capture or hold mode for five seconds after mode transition from armed to capture. A summary of the lateral and vertical mode annunciations and transitions are listed below:

- ***VOR***—A NAV mode (VOR) is armed or has been captured and is being tracked.
- ***HDG***—Heading select mode is engaged.
- ***LOC***—Localizer has been armed or captured.
- ***VAPP***—VOR approach is selected, or course captured has occurred.
- ***GS***—Glide slope is armed or captured.
- ***ASEL***—Altitude preselect is armed (white); altitude preselect transition (green).
- ***ALT***—Altitude hold mode is engaged.
- ***BC***—Back course is armed or captured.
- ***VS***—Vertical speed hold has been selected and captured.
- ***IAS or MACH****—Indicated airspeed (or Mach) hold has been selected and captured.
- ***V-NAV***—V-VNAV mode is armed or captured.
- ***LNAV***—Long-range NAV (FMS) mode has been selected.
- GA—Go-around mode has been selected.

*IAS or MACH is annunciated automatically, depending upon aircraft altitude. Transition from IAS to Mach is automatic as the aircraft climbs through 28,900 feet altitude, and Mach to airspeed occurs automatically as the aircraft descends through 28,700 feet.

Lateral Transitions

- VOR arm to VOR cap
- LOC arm to LOC cap
- BC arm to BC cap
- V_{APP} arm to V_{APP} cap

Vertical Transitions

- VNAV arm to VNAV cap
- VNAV cap to ALT
- ASEL arm to ASEL cap
- ASEL cap to ALT hold
- GS arm to GS cap

Miscellaneous Annunciations

ATT1 (or ATT2)—Attitude source (amber for cross-selection).

DH—Illuminates when the aircraft reaches the preset decision height (annunciated in amber in the upper left side of EADI display).

A white box is drawn around the indication for five seconds when DH is reached.

AP ENG—AUTOPILOT ENGAGED (green). A green arrow points either left or right, indicating to which flight director (pilot or copilot) the autopilot is coupled for guidance.

TCS ENG—Illuminates in amber to indicate touch control steering is engaged.

AP TEST—Illuminates in amber when the autopilot is in test mode. Annunciation is automatic immediately after power-up. It is normally not in view.

TRN KNB—Illuminates in amber when the autopilot turn knob is out of the center detent.

COMPARISON MONITOR ANNUNCIATIONS

Selected pilot and copilot input data are compared in the symbol generator. If the difference between the data exceeds predetermined levels, the out-of-tolerance symbol is displayed on the PFD in amber. A list of the compared signals and the displayed cautionary symbols is given in Table 16-2. When the compared pitch and roll attitude or glide-slope and localizer signals are out of tolerance, a combined level (ATT or ILS) is displayed.

EFIS Equipment Failure Summary

Display Reversion

In the event of failure of one of the PFDs, turning off the failed display DIM knob of the

Table 16-2. COMPARISON MONITOR ANNUNCIATIONS

COMPARED PARAMETER	ANNUNCIATION	TRIGGERING DIFFERENCE
Pitch Attitude	PIT	5°
Roll Attitude	ROL	6°
Heading	HDG *	12°
Localizer	LOC **	Approximately 1/2 dot
Glide Slope	GS **	Approximately 3/4 dot
Pitch and Roll Attitude	ATT	5° and 6°, respectively
Localizer and Glide Slope	ILS **	1/2 and 3/4 dot, respectively
Indicated Airspeed	IAS ***	5 knots
Altitude	ALT ***	200 feet

* If the compared heading sources are not the same (both MAG or TRU), the comparison monitor is disabled.

** These comparisons are active only during flight director, localizer, and glide-slope capture with both NAV receivers tuned to the same LOC frequency.

*** Airspeed and altitude displays flash for ten seconds and then go steady.

respective display controller causes that display to be presented on the multifunction display (MFD). Control of the PFD is still through the respective display controller.

EFIS Equipment Failure Checklist

Failure of equipment feeding information to the EFIS is annunciated by flags or dashes. Failure effects of EFIS equipment are listed in Table 16-3.

Table 16-3. EFIS EQUIPMENT FAILURE CHECKLIST

FAILURE	ANNUNCIATION	FLIGHT DIRECTOR	ANNUNCIATIONS REMOVED PILOT ACTION
Symbol Generator Failure	Red **X** on PFD or display blank	All modes cancel	Select opposite symbol generator on MFD display controller to drive all displays.
Display Controller Failure	Display cannot be changed	N/A	Select opposite symbol generator on MFD display controller to drive all displays.
PFD Failure	Display goes blank	None	Revert display to the FMD display.*
Heading Failure (DC)	Red HDG FAIL on EHSI, map, bearing pointers, etc., removed	Command bars out of view	Select opposite heading gyro by pressing appropriate HDG REV button.
Heading Failure (AC)	HDG flashes in amber on EHSI and heading searches	Command bars search	Select opposite heading gyro by pressing appropriate HDG REV button.
Attitude Failure	ATT FAIL annunciation; no pitch scale or roll pointer, sphere all blue	None	Select opposite vertical gyro by pressing apprörpiate ATT REV button.
Course Deviation Failure	Red **X** through scale and course deviation pointer removed	Command bars, CDI pointer, and applicable bearing pointer off	Revert display o the MFD display.*
Flight Director Failure	FD FAIL on PFD	FD cues and mode	Select opposite flight director on AP XFER FD1/AP XFER FD2 switch, and select opposite SG on MFD SG1/SG2 switch. Mode and display selections must be made on opposite mode selector and display controller, respectively.

* Full counterclockwise OFF position of the DIM knob turns off the failed display and selects the respective display to the multifuction display (MFD) tube.

For detailed information concerning operations of the Primus® 1000 system, consult the Honeywell P-1000 *Integrated Avionics System Pilot Manual* for the Citation V ULTRA, Pub. No. A28-1146-099-00, dated Nov. 1994, or later revision.

EMERGENCY FLIGHT INSTRUMENTS

STANDBY ATTITUDE GYRO

A standby attitude indicator is on the pilot instrument panel (Figure 16-29). It normally operates on main DC electrical power through the STDBY GYRO circuit breaker on the left CB panel. Power to the gyro is controlled by the standby gyro switch, on the pilot lower instrument panel (Figure 16-30) and with switch positions labeled STDBY GYRO, OFF, and TEST. An emergency battery pack in the nose avionics compartment is an emergency source of power for the standby gyro if main DC bus voltage falls below minimum. This is indicated by an amber POWER ON light adjacent to the standby gyro switch, provided the switch is in the STDBY GYRO position. The battery pack also provides power for emergency instrument lighting for the standby gyro, N_1 and ITT indicators, standby airspeed/ altimeter indicator, and the standby HSI.

Figure 16-29. Standby Attitude Gyro

Figure 16-30. Standby Attitude Gyro Switch

The battery pack is continuously charged by the main DC electrical system and should be fully charged in the event of an electrical power failure. The standby gyro power switch must be in the STDBY GYRO position for automatic transfer to emergency battery power. The gyro will operate for a minimum of 30 minutes on emergency battery power. When the switch is held to the TEST position, a self-test of the emergency battery pack and associated electrical circuits is accomplished. The green light adjacent to the switch illuminates if the test is satisfactory and the battery is fully charged.

The standby gyro is caged by pulling the PULL TO CAGE knob and rotating it clockwise (Figure 16-29).

CAUTION

When uncaging, do not release the PULL TO CAGE knob suddenly so that it snaps back; this may damage the gyro.

SECONDARY FLIGHT DISPLAY SYSTEM (MEGGITT TUBE)

The Meggitt Tube is a DC-powered cathode ray tube indicator combining standby attitude indicator, altimeter, and airspeed indications

into one composite instrument. A Mach indication is also included in the instrument.

The secondary flight display system (SFDS) contains solid state inertial sensors for the measurement and presentation of aircraft pitch and bank attitudes. Application of 28-volt DC power to the display system initiates the attitude initialization process, which is identified by the display of the message "attitude initializing" in yellow on the SFDS. The duration of the initialization process is normally less than 180 seconds.

The attitude display has an instantaneous display range of 360° of bank and 50° of pitch. A moving tape on the right side of the display includes a "rolling digit" depiction of altitude; the tape is calibrated in 100 foot increments (Figure 16-31). Baro data is set in the altitude display by a knob on the bottom right of the bezel; clockwise rotation increases the pressure setting and counterclockwise decreases it. The setting is displayed in hectopascals at the top right of the display or in inches of mercury. On the left side of the display is a moving tape showing airspeed. The tape is marked in 10-knot

Figure 16-31. Secondary Flight Display System (MEGGITT TUBE)

increments with a "rolling digit" display in the center. The airspeed display becomes active at 40 knots. The Mach number is displayed in the upper left corner of the display. The Mach display range is 0.35 to 0.999 Mach.

Failure flag indications for airspeed and altitude are red crosses covering the appropriate tape box, with all indications removed from within the box. The failure flags for the Mach indication and Baro Setting are a series of four red dashes in the appropriate display area.

A light sensor is on the bottom left side of the instrument case. It provides ambient light level data to the backlight control system to ensure optimum display brightness. The lighting level can still be controlled manually from the center instrument panel light rheostat control.

The navigation display is selected by the APR button on the bottom of the display bezel. Pressing the button once will display ILS localizer and glide-slope flight director information on the Meggitt tube, provided the NAV 1 receiver is tuned to an ILS. Pressing the button a second time will display Back Course localizer information on the Meggitt tube, provided the NAV1 receiver is tuned to a localizer back course frequency. Pressing the button a third time will remove all navigation information from the Meggitt tube. There is no VOR mode on the Meggitt tube. The standby HSI will display all navigation information (ILS, BC, VOR) from the NAV1 receiver.

NOTE

The standby HSI has no input to the secondary flight display system.

Power to the secondary flight display system is controlled by a switch marked STBY GYRO–OFF–TEST on the pilot lower instrument panel. The SFDS has an emergency source of power from an emergency battery pack in the nose avionics compartment of the airplane. If the airplane bus voltage falls below a minimum amount, the standby power relay will activate

and SFDS power will be supplied from the battery pack. This battery pack also provides emergency instrument lighting for the secondary flight display system, the dual fan (N_1) tachometers, dual ITT indicators, and the standby horizontal situation indicator (HSI).

The battery pack is constantly charged by the airplane's electrical system, and should therefore be fully charged in the event of an electrical power failure. The standby instrument power switch must be ON for automatic transfer to battery power to occur. The SFDS will operate for a minimum of 30 minutes on emergency battery pack power. An amber STBY PWR ON light next to the STBY PWR switch illuminates when the SFDS is turned ON and the airplane's electrical system is not charging the emergency power supply batteries. When the SFDS switch is held to the spring-loaded TEST position, a self test of the battery and circuits is accomplished. The green STBY PWR TEST light, also next to the STBY PWR switch, will illuminate if the test is satisfactory and the battery is sufficiently charged.

Maximum allowable airspeed (V_{MO}) is displayed in analog form by a red warning strip on the airspeed tape. When V_{MO} is reached, the numerals on the numeric airspeed display change from white to red. When the maximum allowable Mach number (M_{MO}) is reached, the numeric Mach number display will also change from white to red.

A built-in test system (BIT) will automatically detect any failure of the display at power up or during continuous operation. If a failure is detected, the appropriate part of the display is replaced with a message indicating the failure. Where it is not possible to display an appropriate message, the display back-lighting is switched off.

STANDBY AIRSPEED ALTIMETER/INDICATOR

A conventionally generated altitude and airspeed will always be indicated, in case of complete DC electrical failure, from the standby airspeed altimeter/indicator on the pilot instrument panel (Figure 16-32). This instrument is powered directly from the standby pitot-static system and requires no electrical power except for anti-ice protection, which is supplied from the emergency DC bus (refer to Chapter 10—"Ice and Rain Protection"). When this instrument is used for primary airspeed reference, the placard directly below the indicator is utilized for airspeed limits.

Figure 16-32. Standby Airspeed Altimeter/Indicator

STANDBY HORIZONTAL SITUATION INDICATOR (HSI)

The standby horizontal situation indicator is a three-inch instrument on the pilot instrument panel (Figure 16-33). It provides navigational guidance in case of PFD/flight director failure.

The standby HSI displays compass heading, glide-slope, and localizer deviation and aircraft position relative to VOR radials. The compass card is graduated in 5° increments, and a lubber line is fixed at the fore and aft positions. A fixed reference aircraft is in the

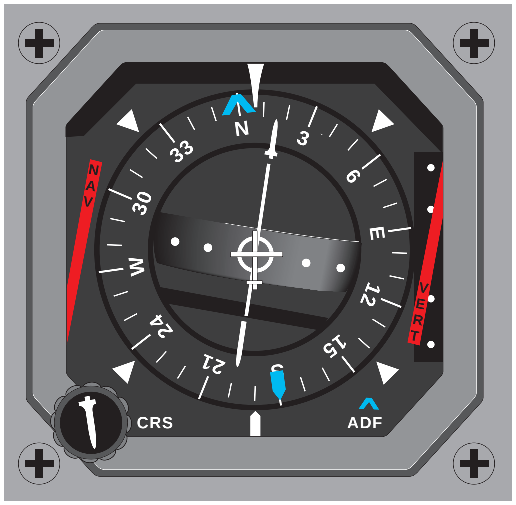


Figure 16-33. Standby Horizontal Situation Indicator

center of the HSI, aligned longitudinally with the lubber line markings.

The course cursor is set by a knob on the instrument. Once set, the cursor rotates in its set position with the compass card. The course deviation bar, which forms the inner segment of the course cursor, rotates with the course cursor. A blue ADF needle, which displays ADF 1 bearings, rotates around the outer portion of the dial .

A heading (HDG) flag appears in the instrument when the compass system is OFF, the heading signal from the directional gyro (DG 1) becomes invalid, primary power to the indicator is lost, or the error between the displayed heading and the received signal becomes excessive.

The course deviation bar moves laterally in the HSI, in relation to the course cursor. Course deviation dots in the HSI act as a displacement reference for the course deviation bar. When tracking a VOR, the outer dot represents 10°, while on an ILS localizer it represents 2 1/2°. White TO-FROM flags point to or from a station along the VOR radial when operating on a VOR. A red warning flag comes into view when power is OFF, NAV information is unreliable, or signals from the NAV receiver are not valid. The standby HSI displays only NAV 1 information.

The glide-slope deviation pointer is to the right side of the display. When receiving glide-slope information during an ILS approach, the green deviation pointer is uncovered by the red VERT warning flag, which otherwise is in evidence. If an ILS frequency is not tuned and being received, or the ILS signal is unusable or unreliable, the deviation pointer is covered by the red warning flag.

MISCELLANEOUS FLIGHT INSTRUMENTS

RAM-AIR TEMPERATURE (RAT) INDICATOR

A digital ram-air temperature (RAT) indicator, on the upper right side of the center instrument panel (Figure 16-34), displays air temperature uncorrected for ram rise. Either Celsius or Fahrenheit may be selected by a switch on the indicator. The temperature sensor is inside the right dorsal fin ram-air inlet.

TRUE AIRSPEED (TAS) TEMPERATURE PROBE

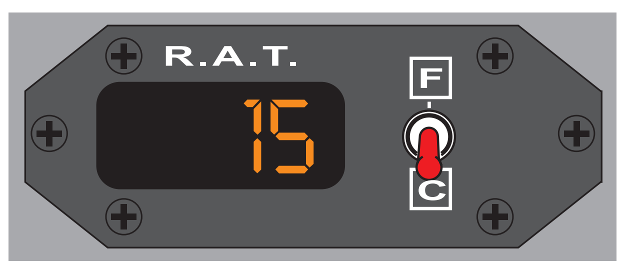


Figure 16-34. Ram-Air Temperature (RAT) Indicator

A true airspeed (TAS) temperature probe (Rosemont) is on the lower right side of the nose section (Figure 16-35). This probe is dedicated to the micro air data computers for

Figure 16-35. True Airspeed (TAS) Temperature Probe (Rosemont)

Figure 16-36. Magnetic Compass

temperature inputs. The probe is anti-iced any time the master avionics switch is on and weight is off the wheels. Anti-ice electrical power is supplied by main DC power through the 15-amp TAS HTR circuit breaker on the pilot CB panel.

MAGNETIC COMPASS

A standard liquid-filled magnetic compass is mounted above the glareshield (Figure 16-36). Directly above the compass are the seating height indicator balls.

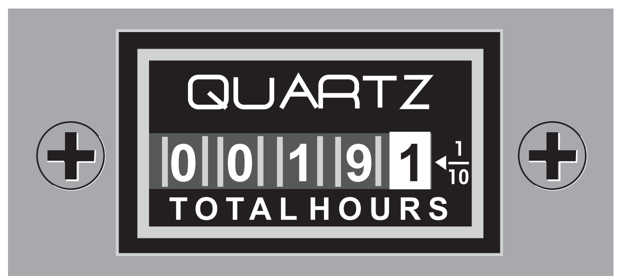


Figure 16-37. Flight Hourmeter

FLIGHT HOUR METER

The flight hour meter, on the copilot upper instrument panel (Figure 16-37), displays the total flight time on the aircraft in hours and tenths. The left landing gear squat switch activates the meter when aircraft weight is off the gear. A small indicator on the face of the instrument rotates when the hour meter is in operation.

Figure 16-38. Davtron Digital Clock

DIGITAL CLOCK

Two Davtron model M877 clocks (Figure 16-38), on the pilot and copilot upper instrument panels, can display four functions: local time, GMT, flight time, and elapsed time. Two versions of

the elapsed time function may be selected: count up or count down.

The clock has two control buttons: SEL (select) and CTL (control). The SEL button is used to select the desired function, and the CTL button to start and reset the selected mode.

For normal operation, either local time or Greenwich Mean Time (GMT) may be selected. GMT is displayed only in 24-hour format, and local time is 12-hour format. Pressing the SEL button sequentially displays GMT, local time, flight time, and elapsed time. The display mode is annunciated GMT, LT, FT, and ET, as applicable, under the time display window.

To set GMT or local time, select the desired function by pressing the SEL button. Simultaneously press both the SEL and the CTL buttons to enter the set mode. The tens of hours digit will start flashing and may be incremented by pressing the CTL button. The next digit is then selected by pressing the SEL button, and similarly set by means of the CTL button. When the last digit has been set, press the SEL button to exit the set mode. At that time the clock starts running and the illuminated annunciator resumes flashing.

To use the clock as a stop watch to time approaches, etc., select ET with the SEL button, and press the CTL button to start the timing. The clock starts counting elapsed time in minutes and seconds up to 59 minutes and 59 seconds. It then switches to hours and minutes and continues up to 99 hours and 59 minutes. Pressing the CTL button resets the elapsed time to zero.

To use the clock for an elapsed time countdown display, select ET for display, and enter set mode by pressing both buttons simultaneously. A maximum countdown time of 59 minutes and 59 seconds can be set. The time from which it is desired to count is entered in the same manner as setting GMT or local time. When the last digit is set, press the SEL button to exit the set mode. Pressing the CTL button starts the countdown. The display flashes when the time reaches zero. After reaching zero, the ET counter counts up. Pressing the CTL button again resets ET to zero.

The flight time mode of the clock is enabled by a landing gear squat switch, which causes the clock to operate any time the aircraft weight is off the landing gear. The flight time may be reset to zero by selecting FT mode with the SEL button and holding down the CTL button for three seconds. Flight time is zeroed when the CTL button is released. A total of 99 hours and 59 minutes can be shown.

A flight time alarm mode flashes the clock display when the desired flight time is reached. To set the alarm function, select FT with the SEL button, and enter the set mode by pressing both buttons simultaneously. Enter the desired alarm time in the identical manner that GMT or local time is set. When flight time equals the alarm time, the display flashes. If FT is not being displayed when the alarm time is reached, the clock automatically selects FT for display. Pressing either the SEL or CTL button turns off the alarm and resets the alarm time to zero. Flight time is unchanged and continues counting.

The clock display may be tested when power is on the aircraft by holding the SEL button down for three seconds. The display shows 88:88, and all four annunciators are activated.

STALL WARNING AND ANGLE-OF-ATTACK SYSTEM

The angle-of-attack system is powered by 28V DC from the left main DC bus and incorporates an angle-of-airflow sensor, a signal summing unit, a vane heater monitor, an angle-of-attack indicator, a stick shaker, and an optional indexer.

The vane-type angle-of-airflow sensor, which is on the forward right side of the fuselage, detects the angle of airflow and deflects accordingly (Figure 16-39). The wedge-shaped vane streamlines with the relative airflow and causes a transducer to send signals to the signal summing unit (computer). Signal inputs concern-

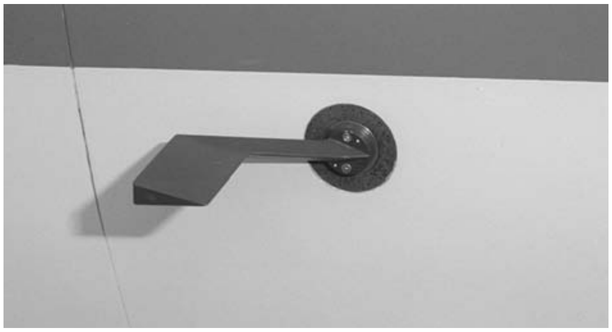


Figure 16-39. Angle-of-Attack Sensor

ing flap position are also received by the signal summing unit. It then compensates for that variable and transmits the information to the angle-of-attack indicator and the optional indexer (Figures 16-40 and 16-41). Indications are accurate throughout the weight and CG range of the aircraft.

The full-range-type indicator is calibrated from 0.1 to 1.0, and marked with red, yellow, and white arcs. Lift information is displayed on the indicator with 0.1 representing near zero lift and 1.0 representing stall. Lift being produced is displayed as a percentage and, with flap position information, is valid for all aircraft configurations and weights. At 1.0 where full stall occurs, 100% of the available

Figure 16-40. Angle-of-Attack Indicator

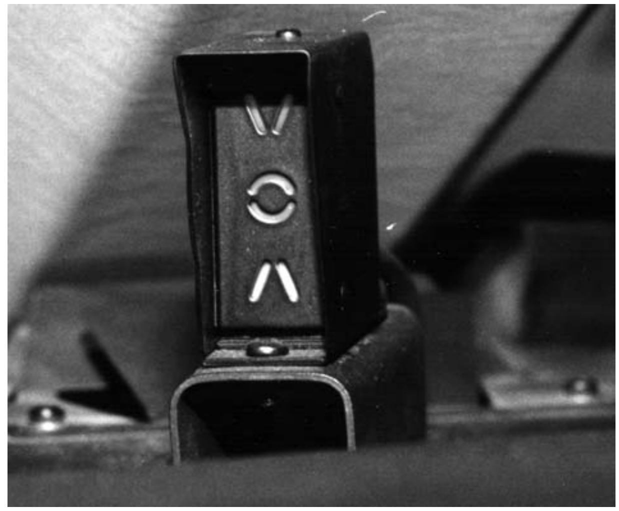


Figure 16-41. Angle-of-Attack Indexer

lift coefficient is being achieved. At the bottom of the scale (0.1) near zero lift is being produced. The area at the lower part of the scale (0.57 to 0.1) represents the normal operating range, except for approach and landing. The narrow white arc (0.57 to 0.63) covers the approach and landing range, and the middle of the white arc (0.6) represents the optimum landing approach (V_{APP} or V_{REF}). The yellow range (0.63 to 0.85) represents a caution area where the aircraft is approaching a critical angle of attack. The red arc (0.85 to 1.0) is a warning zone that represents the area just prior to stick shaker activation and continuing to full stall. At an indication of approximately 0.79 to 0.88 (depending on flap setting and rate of deceleration) in the warning range, the stick shaker activates.

If the angle-of-attack system loses power or becomes inoperative for other reasons, the needle deflects to the top of the scale and stows at a 1.0 indication.

NOTE

The aircraft must not be flown if the stick shaker is found to be inoperative on the preflight check or if the angle-of-attack system is otherwise inoperative.

The stick shaker is on the pilot control column about 9 inches down from the control wheel and on the forward side. The stick shaker provides tactile warning of impending stall. The angle-of-attack transmitter causes the stick shaker to be powered when the proper threshold is reached.

WARNING

If the angle-of-attack vane heater fails and the vane becomes iced, the stick shaker may not operate or may activate at normal approach speeds.

An optional approach indexer (see Figure 16-41), on the pilot glareshield, provides a heads-up display of deviation from the approach reference. The display is in the form of three illuminated symbols which are used to indicate the aircraft angle of attack. High angle of attack is analogous to low airspeed; low angle of attack is analogous to high airspeed.

Illumination of the symbol is progressive as the aircraft angle of attack changes. When the aircraft speed is on reference, the green center circle is illuminated. As the speed decreases from reference (.6), the circle illumination dims and the top red chevron illumination increases until the top chevron is fully illuminated and the circle is extinguished. As the angle of attack becomes high, the top red chevron begins to flash.

When the aircraft is accelerating from the on-speed reference, the illumination of the green circle dims and illumination of the bottom yellow chevron increases until the circle is extinguished and only the bottom chevron is illuminated.

The top red chevron points down, indicating that the angle of attack must be decreased to eliminate the deviation. The bottom yellow chevron points up to indicate that the angle of attack must be increased to eliminate the deviation.

The indexer is active any time the nose gear is down and locked and the aircraft is not on the ground. There is a 20-second delay after takeoff before the indexer activates.

Stall strips on the leading edge of each wing (Figure 16-42) create turbulent airflow at high angles of attack, causing a buffet to warn of approaching stall conditions. This system is considered a backup to the angle-of-attack stick shaker system in case of malfunctions and electrical power failures.

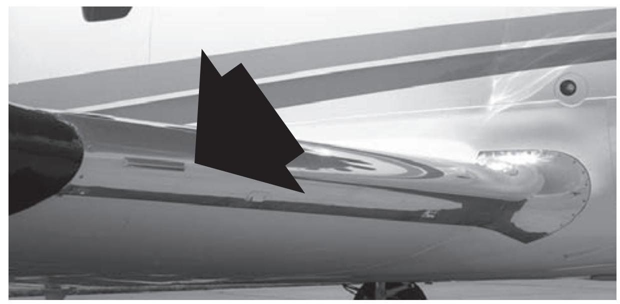


Figure 16-42. Wing Stall Strips

COMMUNICATION/ NAVIGATION

VHF COMM TRANSCEIVERS

Dual VHF-22A transceivers are remotely in the tail cone. They are individually controlled by CTL-22 control heads on the right side of the center instrument panel (Figure 16-43). The COMM 2 antenna is on the underside of the fuselage, and the COMM 1 antenna is mounted in the vertical stabilizer cap. The COMM 1 radio is powered from the emergency DC bus.

HF COMMUNICATION (OPTIONAL)

An optional KHF-950 HF radio may be installed. Control is achieved through a KFS 594 control panel on the upper right side of the center instrument panel (Figure 16-44). The KHF-950 is a 150-watt transceiver system that

Figure 16-43. Console Control Heads

Figure 16-44. HF Radio Control Panel

provides 280,000 frequencies at 100-Hz increments with 19-channel preset capability in the HF band (2.0000 to 29.9999 MHz). It operates in AM and single sideband. Upper sideband (USB) is the normal mode of operation, but lower sideband (LSB) is also available. In TEL (A3J), any of the ITU telephone channels (401 through 2241) may be selected.

FLITEFONE VI

The Flitefone system provides air-to-ground telephone communication. It operates in the ultra high frequency (UHF) band and is a frequency modulated (FM) unit. The operating frequency is in the 450 MHz range. Twelve telephone channels are provided plus one ground-to-air selective calling channel (SEL CALL).

The standard cabin location of the Flitefone (Figure 16-45) is in the armrest of passenger seat number six, at approximately mid cabin. The standard cockpit location of the Flitefone is on the cockpit divider near the copilot right shoulder.

Figure 16-45. Flitefone VI

The base of the Flitefone is equipped with a switch (HF-BELL OFF-PHONE) which may be used to silence the bell if the passenger does not wish to be disturbed, to select Flitefone function (PHONE), or to connect the Flitefone push-to-talk (PTT) switch on the side of the handset to the high frequency (HF) radio in order to key the HF microphone, allowing the Flitefone to be used in the HF mode. For the Flitefone to be used in HF mode, the HF COCKPIT/HF CABIN switch on the instrument panel must have HF CABIN selected.

The Flitefone also serves as a cabin/flight compartment interphone. To use the system as an interphone, dial 4(i)-2(C)-# Key. The audio signal will sound in the other unit and the IC indicator light will illuminate and remain on as long as the handset is off the cradle. The intercom system can be used at any time, even while in queue.

To place a telephone call, ascertain that the system is in Flitefone mode (PHONE). The aircraft must be within range of a ground station in order to complete a call. The Flitefone VI offers the capability to dial directly from the aircraft if desired; however, not all ground stations have direct dial capability and the aircraft may not be in range of such a station. The direct dial (D/Dial) LED in the base of the Flitefone will illuminate if the ground station contacted has that capability. If a dial tone is heard and the direct dial LED is illuminated, a direct-dial air ground radio telephone automated service (AGRAS) call may be made.

To initiate the call, remove the handset from the base, observe the D/Dial light and listen for a dial tone. If a regular dial tone is heard and the D/Dial light illuminates, dial 1 (or 0)+area code+the desired number. (Dialing 0 first allows billing to a long distance credit card number.) If a pulsed dial tone is heard and the D/Dial light illuminates, it indicates a busy channel and that queuing is necessary. Dial 1 (or 0) + area code + desired number; listen to the audio; an alternating tone will be heard in a few seconds. Hang up the handset. When the call in progress is completed, the ground station will complete the call and will call you. The queue may be canceled by pressing the * key.

If the handset is removed from the base, the D/Dial light does not illuminate, and there is a high-pitched tone in the handset, it indicates that direct dialing is not available. Dial 8 + 9 + # Key. The ground station attendant will respond, requesting billing information and desired number.

If a voice is heard when the handset is removed from the base, momentarily depress the hookswitch. If a voice is still present, place the call later. If a standard busy signal is heard, place the call later.

If in range of a station with direct dial capability but a manual (operator-assisted) call is desired, ascertain that the D/Dial light is on and that the dial tone is present; then dial 8 + 9 + # Key. The ground station attendant will respond.

Manual selection of a desired channel is possible, if desired. Dial the channel number (there are 12 channels available) + # Key. If that channel is available at that location, a dial tone, high pitched tone, etc., will be heard as described above, and the call is completed using the appropriate procedure described for the tone heard. If silence or voice conversation is heard, dial another channel and proceed until a usable station is available.

A rapid busy signal (re-order tone) indicates faulty dialing or other difficulty. If such a signal is heard, hang up and try the procedure again.

If in range of a ground station offering automatic dialing capability, and when properly dialed, the Flitefone VI will automatically scan and lock onto the best available ground station, process the number dialed, complete the connection, and the call is ready. Should the number be busy, the last number called will be stored in memory for automatic redial.

Operator's Manual

For detailed information concerning operation of the Flitefone VI, consult the Flitefone VI Operator's Manual, Revision E, or later revision, of the Global-Wulfsberg™ Systems Division of Sundstrand Data Control Inc.

COCKPIT VOICE RECORDER

The cockpit voice recorder (Figure 16-46) system provides a continuous recording of the last 30 minutes of all voice communications and aural warnings occurring in the cockpit, as well as communications involving the aft public address audio.

Figure 16-46. Cockpit Voice Recorder

A sensitive cockpit microphone may be in the overhead console, adjacent to or in the glareshield fire tray, or in the instrument panel. The recorder is energized any time the battery switch is in the BATT position. This assures CVR operation from start of preflight to the end of the final checklist. System operation may be checked by means of a test switch on the recorder system control panel. Pressing the erase button for 2 seconds will erase the entire recording. Erasure can only be accomplished on the ground.

UNIVERSAL FLIGHT DATA RECORDER UFDR FXUS (OPTIONAL)

The universal flight data recorder (UFDR) provides a permanent record of several parameters of aircraft performance on a crash-survivable magnetic tape which has sufficient capacity to store information concerning the last 25 hours of flight time. The data is recorded continuously in digital form on the tape and includes at least a record of the aircraft altitude, airspeed, heading, vertical acceleration, and microphone keying. Aircraft configured to carry ten or more passengers must comply with Appendix E of FAR Part 91, which requires several additional parameters to be continuously recorded.

An integrity monitoring function detects power loss or other failure and illuminates the RECORDER PWR FAIL warning light.

VHF NAVIGATION RECEIVERS

Dual VIR 432 navigation receivers provide VOR, localizer, glide-slope, and marker beacon capability. The receivers are in the tail cone. CTL-32 controls are on the lower right side of the center instrument panel (see Figure 16-43). Each system has 200 VOR/LOC operating channels, 40 glide-slope channels, and automatic DME channeling. Multiple outputs drive the flight director, EHSI, standby HSI (No. 1 only), and the autopilot. All basic functions have a built-in self-test. Consult Section III of the Aircraft Operating Manual and vendor pilot handbooks for operating instructions.

AUTOMATIC DIRECTION FINDER (ADF)

The Collins ADF-462 is controlled by a CTL-62 electronic head mounted on the right side of the center instrument panel (see Figure 16-43). The control head has two digital readouts to display the active frequency and a preset frequency. Four additional frequencies may be stored in memory. ADF magnetic bearings are displayed on the PFDs (single-bar blue pointer) and on the standby HSI (ADF No. 1 only). A second ADF-462 may be installed as an option, in which case the first system is duplicated except the bearing information is displayed on the PFD double-barred white pointer only, if selected. In single ADF installations, the ADF No. 2 pointer will not display or become visible.

MARKER BEACON SYSTEM

The marker beacon, VOR, localizer, and glide-slope receivers are all combined into one navigation receiver. Each NAV receiver encompasses all of those functions. System operation is similar and equally automatic if either the standard or the optional VHF radio system (Primus® II) is installed.

NAV 1 provides signals to the following:

- Marker beacon data to the pilot marker beacon annunciators in the center right side of the primary flight display (PFD)
- VOR, localizer (ILS), and marker beacon signals to the audio control panels

NAV 2 provides signals to the following:

- Marker beacon data to the copilot marker beacon annunciators in the PFD
- VOR, localizer (ILS), and marker beacon signals to the audio control panels

The marker beacon receivers are in operation whenever the NAV receivers are ON. They operate on a frequency of 75.00 MHz. The annunciators in the PFDs are part-time displays. A white box identifies the location of the marker beacon annunciator when a localizer frequency is tuned. The marker beacons are annunciated by the appropriately colored letters: a blue O for outer marker, an amber M for middle marker, and a white I for inner marker. The letters appear in the white box when the marker beacon receiver is activated. A marker beacon tone is transmitted to the audio control panel and is heard in the speaker/headset, if selected. A 400-Hz tone is heard at the outer marker, a 1,300-Hz tone at the middle marker, and a 3,000-Hz tone at the inner marker.

The audio muting system (MKR MUTE) provides the pilots with a method of temporarily cutting out the marker beacon audio. When pressed, the marker beacon signal is muted for approximately 30 seconds. The MKR MUTE switches (pushbuttons) are on the audio control panels (Figure 16-47).

Figure 16-47. Audio Control Panel

LOCATOR BEACON

The emergency locator beacon (ELT) system is an emergency transmitter designed to assist in locating a downed aircraft. The transmitter has a self-contained battery pack which must be changed every three years or after a cumulative total of one hour of operation. The system is activated automatically by an impact of 5.0+2/-0 G along the flight axis of the aircraft, or manually by a remote EMER-NORM switch on the copilot lower instrument panel (Figure 16-48). When the transmitter is activated, a modulated omnidirectional signal is transmitted simultaneously on emergency frequencies 121.50 and 243.00 MHz. The modulated signal is a downward-swept tone signal starting at approximately 1,600 to 13,300 Hz and sweeping down every two to four seconds continuously and automatically.

Figure 16-48. ELT Switch

The transmitter has an ARM-ON-OFF switch which is normally left in ARM. The ON position is used to test the system from the ground, and the OFF position turns the system off.

The guarded EMER-NORM switch on the instrument panel provides a manual activation of the system as well as a means of testing the operation. In NORM position, the system is armed for activation by the impact switch. In EMER position, the impact switch is bypassed, and the emergency signal is transmitted.

EMER position can be used to test the system; however, prior approval from control tower and flight service must be obtained. A RESET button is next to the EMER-NORM switch on the copilot instrument panel. Pressing the RESET button resets the ELT transmitter if it has been energized by the impact switch. The RESET button must be held depressed for a minimum of three seconds. A remote control, accessible from outside the aircraft, is on the left side of the dorsal fin under a plug button. The ELT can be turned ON, OFF, or RESET from that control. Two flush-mounted antennas are on either side of the dorsal fin just forward of the vertical fin.

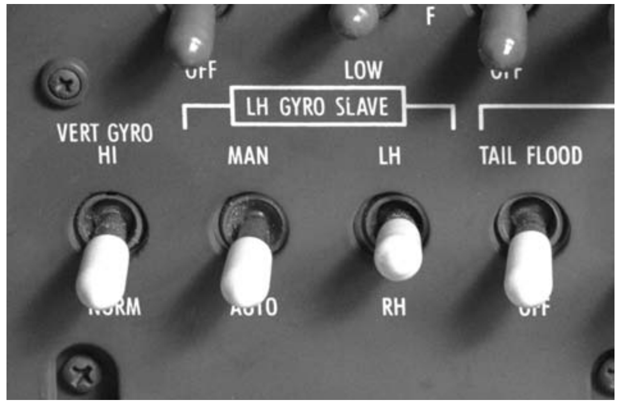


Figure 16-49. Gyro Switches

C-14D COMPASS SYSTEM

Pilot System

The flight director and the flight director display on the pilot PFD, the autopilot (except when AP XFER FD 2 is selected), and the standby horizontal situation indicator are driven by the pilot C-14D slaved gyro system. The system consists of a directional gyro, a flux detector, a mode selector switch, a remote compensator, and a slaving indicator on the PFD. The directional gyro operates on 28 VDC from the emergency bus. In the event of a DC power failure, placing the battery switch to the EMER position regains the pilot C-14D and provides gyro-stabilized heading information through the standby HSI. The mode selector switch is on the left switch panel and is labeled LH GYRO SLAVE (Figure 16-49). It has two positions: MAN and AUTO. In the MAN position, the C-14D gyro operates in unslaved (gyro) mode. In the AUTO position, it operates in slaved (gyro-stabilized magnetic) mode. When MAN is selected, the HSI compass card can be moved left or right at a rate of 30° per minute by toggling the LH/RH switch, to the right of the MAN/AUTO switch, to the RH or LH position. Manual operation gives accurate short-term heading reference when magnetic information is unreliable (DG 1 will be displayed on the PFD).

Under normal operating conditions, the pilot C-14D gyro slave switch should be left in the AUTO position. Fast slaving in the AUTO mode occurs at a minimum rate of 30° per minute and continues that rate until the gyro is slaved to the magnetic compass heading. It then continually maintains slow slaving rate of 2.5 to 5.0° per minute. If the gyro slave switch is in AUTO position at power-up, the system slaves itself. If the gyro has obtained operating speed in the MAN position, or is otherwise unslaved while operating, the LH/RH switch must be activated to start fast-slaving action in the AUTO mode.

Copilot System

The copilot C-14D compass system is the same as the pilot C-14D. The copilot C-14D system drives the copilot flight director and the flight director display on the copilot PFD, and when AP XFER FD 2 is selected on the autopilot transfer switch, it provides heading guidance to the autopilot through the pilot IC-600 display guidance computer.

Two RH GYRO SLAVE switches, marked MAN/AUTO and LH/RH, are low on the copilot instrument panel. Operation of the switches is the same as described above in the pilot C-14D system.

For operation in the manual mode, DG 2 will be displayed on the copilot PFD.

NOTE

If a C-14D compass should fail (indicated by a HDG FAIL flag on the respective PFD), selecting HDG reversion allows one C-14D compass system to provide heading steering information to both the pilot and copilot flight directors, flight director displays, and PFDs. If the pilot C-14D system should fail, the standby HSI will be inoperative. The PFD EHSIs require AC power for operation (supplied by the aircraft inverters). If both inverters should fail, the battery switch must be placed in EMER to provide emergency AC power (26 VAC) from the pilot C-14D directional gyro power supply to power the standby HSI.

VG-14A VERTICAL GYRO SYSTEM

The pilot and copilot VG-14A vertical gyro systems are powered by the aircraft AC system (inverters). The pilot system provides pitch and roll information to the No. 1 IC600 display flight guidance computer, consequently providing pitch and roll data to the autopilot, pilot flight director, and PFD.

The copilot VG-14A provides pitch and roll information to the No. 2 IC600 computer, which in turn, provides pitch and roll data to the copilot flight director and PFD. However, if ATT reversionary is selected on the pilot instrument panel, the copilot VG-14A vertical gyro provides pitch and roll information to the autopilot, provided the No. 1 IC600 is operational. Utilizing either the pilot or copilot reversionary ATT switch causes the opposite VG-14A to drive both flight directors, PFDs, and the autopilot. If both vertical gyros fail, the standby gyro must be referenced for attitude information.

AUDIO CONTROL PANELS

Two audio control panels (see Figure 16-47) provide individual audio selection by each pilot. Three-position switches labeled SPKR, OFF, and HDPH enable all audio inputs to be selected to the overhead speakers or headphones. A two-position IDENT—VOICE switch is used with the NAV and ADF switches to monitor either voice or coded identifiers. Two concentric MASTER VOLUME knobs control the headset or speaker volume of all selected audio sources. A PASS SPKR VOLUME knob controls the output volume of the passenger compartment speakers.

A rotary microphone selector switch has four standard positions: COMM 1, COMM 2, PASS SPKR, and EMER/COMM 1. A fifth position labeled HF is included if an operational HF radio is installed. COMM 1 or COMM 2 connects the microphone being used to the respective VHF transmitter. PASS SPKR provides for announcement to the passengers through the cabin speakers; COMM 1, COMM 2, and HF audio are muted. The EMER/COMM 1 position bypasses the audio amplifier, necessitating the use of a headset, and volume control is available only at the radio control head. Transmitting remains normal from all microphone sources.

A three-position AUTO SEL switch with SPKR, OFF, and HDPH positions automatically selects the proper speaker or headphone to match the position of the rotary microphone selector switch. All audio sources can be monitored at any time by the use of the appropriate SPKR—OFF—HDPH switch, regardless of the microphone selector switch or the AUTO SEL switch positions. A MKR MUTE button silences the marker beacon audio for approximately 30 seconds.

HONEYWELL PRIMUS® II REMOTE RADIO SYSTEM — VHF COMM (OPTIONAL)

The RCZ-850 integrated communications unit normally operates in the frequency range of 118 to 136 MHz. The unit can be strapped to

extend the upper range to 152 MHz for operation in parts of the world where those frequencies are used. The RCZ-850 unit is the communications component of the SRZ-850 integrated radio system. The COM radios are controlled from the RM-850 radio management unit (RMU), two of which are mounted on the center instrument panel. COM 1, NAV 1, ADF 1, etc., are controlled by the left RMU. The COM 2, NAV 2, and ADF 2 (if installed) are controlled by the right RMU. The unit being controlled is annunciated on the control display unit of the RMU. The four radio functions: COM, NAV, ATC (transponder), and ADF which are controlled by the RMU are all displayed on page one (main frequency select page) of the RMU. Tuning control for the desired function/parameter is obtained by pressing the line select key next to that function/parameter. The COM radio has a memory capacity for up to 12 frequencies to be selected and stored for later use.

Controls and Indicators

Normally the COM radios are controlled through the controls and display in the upper left corner of the radio management unit (RMU). Any selectable parameter is changed by pressing the corresponding line key next to the displayed parameter. This brings an amber box (cursor) to surround that position, which allows it to be tuned by the single controller tuning knob on the bottom of the RMU.

Tuning of the COM radios is accomplished by three methods. The first method, discussed below, also provides methods to store frequencies in the memory locations. This is considered the normal method. Storing of the frequencies while tuning is not required; however, it is discussed here only because it may be convenient to store the frequencies as they are used for later use. The second method is direct tuning, and the third method is remote tuning through the auxiliary COM1/NAV 2 control display unit control head. This may be used when only battery power is available or desired, or in case of an emergency. Operation of the auxiliary COM 1/NAV 2 control display unit control head is discussed at the end of the COM section.

Normal, or preselect tuning of the COM radios is accomplished in the following manner: press the line key next to the second COM frequency line displayed on the RMU—the amber box will move to that position if it is not already there; set the desired frequency by means of the concentric tuning knobs at the bottom of the RMU; press the upper left button on the RMU bezel (the one with vertical arrows), which will switch the pretuned frequency with the active frequency. When a frequency is preselected (set in the second line), this may result in the changing of a frequency which was identified by MEMORY, plus a number from 1 to 12, below the active frequency. The prior number has been stored in memory and the imposition of the second frequency over it is only temporary (which is identified TEMP). This will not result in the new frequency being stored in the memory unless the STO button is pressed before the frequency is transferred to the active location (top line). In this case, the word TEMP will be replaced by the word MEMORY plus the memory position number. The pilot may progress through all 12 of the memory locations by pressing the line key near the line identified by TEMP or MEMORY in the COM box (upper left hand corner), which will move the amber box to surround that line. Turning either the large or small tuning knob will then select each memory space sequentially, showing the frequency stored there in blue on the line above the MEMORY annunciator line. Vacant memory locations will not appear. When the last occupied memory location is selected, the frequency shown on the second line, which was a temporary frequency in memory, will again be shown to occupy that space, plus the word TEMP, indicating that it is not stored in MEMORY.

When progressing through the stored memory locations, the frequency in the memory location being displayed can be transferred into the active position (tuned) simply by pressing the upper button (the one with the vertical arrows).

If the pilot desires to view all of the stored frequencies at once, he may press the PGE (page) button at the bottom of the RMU and the active frequency, with a maximum of six stored frequencies, will be displayed along with the number of their memory location. Pressing the line key adjacent to the MORE annunciator will advance the page to show the remaining frequencies with their location numbers of 7 through 12. If it is desired to insert a frequency in any particular location on these pages, move the cursor to that location by pressing the line key next to the desired memory location and the tuning knob will control that selection. The memory locations must be filled sequentially, i.e., blanks cannot be left open. If memory location eleven is vacant, for instance, and an attempt is made to store a frequency in location twelve, the word "can't" appears in amber at the bottom of the page. It is not necessary to push STO to store the frequency. If deletion of a stored frequency is desired, press the line key adjacent to that memory location and press the line key adjacent to the DELETE annunciator. Higher memory locations will move down to fill the vacant space. If the pilot desires to place a frequency in a particular memory location, press the line key at that location to move the amber box there; press the line key at the INSERT location. The frequencies at the selected location and at higher location numbers will move up one location. The frequency in the selected location may then be modified and it will be stored.

If all the memory locations on the first memory page are not filled, the second memory page cannot be accessed.

Direct tuning of the COM radio is accomplished by selecting the cursor (amber box) to the COM preset location (second frequency line), and pressing the line key at that position for a minimum of three seconds. The preset frequency will disappear and the cursor will move and enclose the active frequency. Direct tuning is then available. Preset tuning may be restored by pressing the same button again.

An additional feature provided by the SRZ-850 integrated system, is stuck microphone protection. The COM transmitter has a two-minute timer which cuts off transmission after that time has elapsed if the MIC key has not been released. A short warning tone is sounded a few seconds before the automatic shutoff. When the microphone cutoff has been activated at the two-minute limit, a MIC STK warning in red will be annunciated in the upper left corner of the RMU.

A TX annunciation at the top of the COM frequency window will annunciate whenever the transmitter is active.

When the second (first memory location) page of the display is selected, a NARROW BANDWIDTH SELECT annunciation will appear in the upper right corner of the display. Narrow bandwidth is the normal selection; however, a wider bandwidth may be selected for use in areas where slightly off-channel transmitters are used. Its selection will result in improved reception in such areas. The selection is made by pressing the double arrow selector next to the annunciation. Another press of the selector will return the selection to the original.

If any of the components of the radio system fail to respond to tuning or operating commands of the RMU, the frequency or operating command associated with that particular function will be dashed out. This alerts the crew to a failure or abnormal system operation.

Cross-side operation of the RMU is possible by pressing the 1/2 button on the bottom of the RMU. This allows the operator to tune the opposite side radio system from that RMU. The tuning will be followed on the other RMU and so indicated. The system banners will be indicated in magenta color to serve as a reminder of the cross-tuning condition.

Each time the integrated radio system is powered up with the landing gear squat switches activated, a power on self-test (POST) will be activated. If any radio or bus fails any test parameter, an error message will be displayed

on a test results page. If no errors are detected, the main tuning page will be displayed.

A pilot activated self-test (PAST) may be initiated by pressing the TST button on the RMU. A complete test will then be accomplished on the component represented by the window at which the yellow cursor is located. At the completion of the test, a legend will appear in the window for a short time to indicate successful completion. If the test is not successful, an error message will appear to indicate which circuit area has failed.

By pressing the DIM button on the bottom of the RMU, the tuning button may be used to dim the display. Exit from the dim mode is accomplished by pressing the DIM button again. Variations in ambient light will be automatically sensed, within limits, and automatically adjusted to maintain a desired setting.

HONEYWELL PRIMUS® II REMOTE RADIO SYSTEM—NAV (OPTIONAL)

The RNZ-850 integrated navigation unit (Figure 16-50) operates in the frequency range of 108.00 to 117.95 MHz. The RNZ-850 system encompasses the functions of VHF NAV, localizer and glideslope receiver, and marker beacon receiver, as well as the addition of the ADF and DME functions which, in conventional systems, are separate units. Operation of the ADF and DME modes will be covered in the section where operation of the standard ADF and DME installations are discussed. Operation of the marker beacon system is discussed under Marker Beacon below.

Glideslope paired frequencies are tuned with the published ILS frequencies as in standard VHF NAV practice. The RNZ-850 is the navigation component of the SRZ-850 integrated radio system. The two NAV integrated receivers are

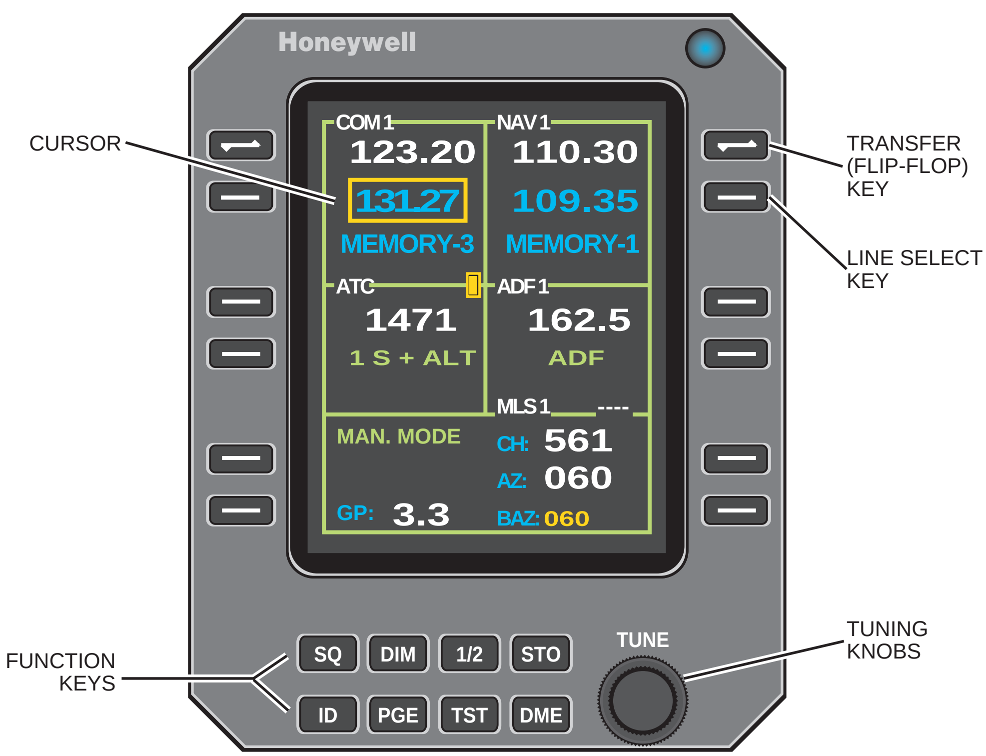


Figure 16-50. Honeywell Primus® II Remote Radio System (Optional)

controlled and tuned in a similar manner to the RCA-850 COM units discussed under Primus® II Remote Radio System—COM. A minor difference is the requirement for the PGE (page) button to be pressed twice in order to access the NAV page which shows the first six NAV memory locations. Otherwise, changing, storing and deleting frequencies is accomplished in the same manner.

The NAV frequency window on the main tuning (first) page has an additional function called the DME Split Tuning Mode. This function involves DME hold plus some additional features, and is discussed under Distance Measuring Equipment in the Pulse Equipment part of this section.

NAV 2 is also tunable by the Auxiliary COM 1/NAV 2 control display unit. Tuning of the CDU is discussed under Auxiliary COM 1/NAV 2 Control Display Unit in this section.

Both NAV 1 and NAV 2 are selectable on the pilot and/or copilot DC-550 display controller to be displayed on the respective PFD. If both PFDs are displaying the same NAV source, the annunciation will be in amber.

Operation of the NAV displays on the standby horizontal situation indicator (HSI) is discussed in the NAV section.

HONEYWELL PRIMUS® II REMOTE RADIO SYSTEM—ADF (OPTIONAL)

The automatic direction finder (ADF) function of the Primus® II Remote Radio System is provided by the DF-850 ADF receiver module, which is a component of the RNZ-850 integrated navigation unit. As discussed in the COM section above, the tuning of the complete system, which includes the ADF, is accomplished by means of the remote management unit (RMU), the RM-850.

The receiver has a frequency range of 100.00 to 1799.5 KHz in 0.5 increments. A strap selectable option is available which allows tuning of marine emergency frequency of 2181 through 2183 KHz.

Four modes of operation are available on the DF-850 ADF:

- ANT (Antenna)
- ADF (Automatic Direction Finder)
- BFO (Beat Frequency Oscillator)
- VOICE

In ANT mode, the ADF receives only and does not compute bearing information. In ADF mode, the system receives signals and computes relative bearing to station. In BFO mode, a beat frequency oscillator is added to the signal for reception of CW signals. In VOICE mode, the reception bandwidth is widened for improved voice audio on the frequency. The VOICE mode is not used for navigation. Bearing information is available only in ADF and BFO modes. If ANT is used for tuning, random ADF needle searching is prevented. The modes are selected by pressing the lower line key adjacent to the ADF window. Progression is: ANT; ADF; BFO; and VOICE. The mode changes each time the line key is pressed. When the tuning cursor (amber box) surrounds the lower ADF line, the ANT, ADF, BFO, and VOICE progression may also be selected by turning the tuning knob.

When the line select key adjacent to the frequency window of the ADF is pressed, the cursor will move to the ADF frequency window and the ADF may be tuned by the tuning knobs. Tuning is in 0.5 KHz increments with the small knob and 10 KHz with the large knob. If the knobs are turned faster larger increments are selected for each turn enabling large changes to be made in much less time. The rate of increased tuning speed is proportional to the rate the knobs are turned.

The ADF has a scratch pad memory which will store one frequency. This is accomplished by selecting the desired frequency and pressing the STO button for two seconds. To retrieve the frequency from memory, press the line se-

lect key adjacent to the ADF frequency window for two seconds.

The ADF bearing information may be selected on the O bearing needle of the pilot electronic primary flight display (PFD). If dual ADFs are installed, the ◊ bearing pointer will display ADF 2, when selected. Selection is accomplished by means of the bearing knobs (O and ◊) on the respective DC-550.

On the PFDs the single bar needle displays ADF 1 (when ADF is selected) and the double bar needle displays ADF 2 (when selected, if installed). In the standard single ADF installation, ADF information is not available in the ◊ needle, i.e., ADF 2 needle will not display.

HONEYWELL PRIMUS® II REMOTE RADIO SYSTEM—ATC (OPTIONAL)

The ATC (transponder) function of the optional SRZ-850 integrated radio system is provided by the XS-850 transponder module, which is a sub-unit of the RCZ-850 integrated communication unit. It functions as a 4096 code mode A transponder, as well as providing mode C (altitude) and mode S (collision avoidance) information. Altitude information is provided by the respective (1 or 2) AZ-840 micro air data computer in the pilot or copilot Primus® 1000 system.

General tuning information concerning the SRZ-850 system is discussed under Primus® II Remote Radio System—COM in this section. Specifically, tuning of the transponder is accomplished by pressing the line key adjacent to the desired ATC function on the left side of the main tuning page which is displayed on the RMU. The ATC window has two lines. The top line represents the tuneable transponder codes and the second line represents the transponder modes. When the line key adjacent to the transponder code line is pressed, the amber box (cursor) will surround the code digits, which are then tunable by the tuning knobs. The large knob controls the left two digits, and the small knob controls the right two digits.

Pressing the mode select line button moves the cursor box to the mode select annunciator which connects the tuning knobs to that window. Either knob may then be used to select modes in the following sequence:

- ON—System in Modes S and A, no altitude is reported.
- ON+ALT—Replies on Modes A, C and S.
- S ONLY—Mode S operation only.
- S+ALT—Mode S with altitude reporting (Mode C).

Only one transponder is in operation at one time; the opposite one is held in STANDBY for instantaneous operation, if required. The system in operation is controlled by the mode select line key. Pressing the mode select line key (once the cursor is moved to that line) cycles the transponders as follows:

- STANDBY—Both units in STANDBY.
- SYSTEM No. 1 in operation.
- STANDBY—Both units in STANDBY.
- SYSTEM No. 2 in operation.
- STANDBY—(sequence will repeat).

The system in operation is indicated by a 1 or 2 in front of the selected mode.

A transponder code may be stored in memory. To accomplish this, select the desired codes and press the STO button for two seconds. To retrieve the code from memory, press the line select button for two seconds.

The INDENT function of the transponder may be activated by pressing the ID button on the RMU or by pressing the ID button on the inboard side of either the pilot or copilot control wheel. Pressing any ID button will activate the ID mode for approximately 18 seconds. An amber ID annunciation will appear along the top edge of the transponder window during ID mode activation.

HONEYWELL PRIMUS® REMOTE RADIO SYSTEM— DME (OPTIONAL)

The optional Primus® II DME system is comprised of systems which are organized into compact modules. Each module, concerning the DME system, is comprised of an RNZ-850 integrated navigation unit, an NV-850 VHF NAV receiver and a DME-850 (Figure 16-51) distance measuring module. The DME transmitter of the DME-850 works in the L frequency band, and the receiver frequency range is from 962 to 1213 MHz. DME tuning normally follows the VHF NAV receiver tuning which selects the DME frequencies paired to the VHF VORTAC published frequencies. The Primus® II, however, has a special hold function which also allows the tuning of military TACAN channels in order to receive the DME portion of the TACAN signals.

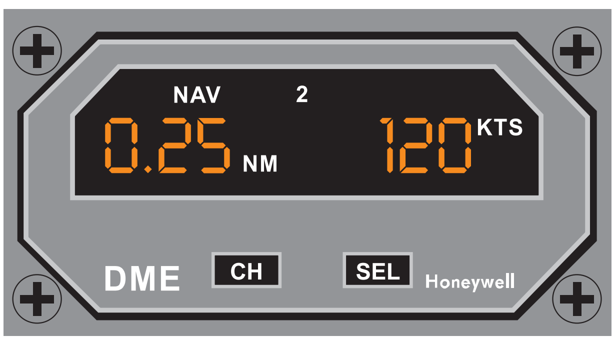


Figure 16-51. DI-851 DME Indicator

The DME has the capability to scan six channels, simultaneously tracking four selected DME channels for distance, ground speed and time-to-station, as well as tracking two stations for identification (IDENT) functions. Of the four channels which can track three functions (DIST, GS and TTG), two are dedicated to the flight management system (FMS).

Normally, one DME station will be tuned to an active VOR frequency, which is annunciated on the top line of the NAV tuning window of the radio management unit (RMU). Another (preset) VOR frequency may be selected in the preset frequency window. When a frequency is set in the preselect window, the system will already by tracking the preselected station so that there will be no delay when that frequency is transferred to active.

NAV tuning, which normally also selects the associated DME frequencies, is discussed under Primus® Remote Radio System—NAV in this section. Special tuning procedures applicable to DME, which are in addition to the NAV tuning, will be discussed.

Two DI-850 indicators are installed; one on the pilot and one on the copilot instrument panel. DME information is presented on the DI-850 DME indicator and, when selected on the DC-550 display controller, on the pilot and copilot EHSIs. The channel (CH) button allows selection of NAV 1 or NAV 2 on either DI-850 indicator; each indicator can be selected to its own side or on the opposite side. Selections on the CH button on the indicator will not affect the selection(s) made on the DC-550 display controller, which controls the display on the respective EFIS. A selection on one DI-850 indicator will not effect the selection on the opposite indicator.

NAV 1 or NAV 2 will be annunciated on the top line of the indicator to indicate which NAV is being displayed and computed. If the DME is being held, HLD is annunciated on the top line along with NAV 1 or NAV 2 to indicate which channel the DME is holding. When a station is being held, the regular functions are selectable on the DI-850 indicator and information will be computed from the station identified by H on the DME line of the RMU; however, after 15 seconds, the DI-850 annunciation will revert to identifier.

The select (SEL) button on the indicator is used to cycle the display on the right side of the readout through ground speed, time-to-station, and IDENT functions. If HOLD is selected on the DME, the function will return to IDENT in 15 seconds if any other function is selected.

The DME has a split tuning mode which operates somewhat like conventional HOLD

functions, but provides other options. Pressing the DME button on the bottom of the RMU will divide the NAV window into two windows. The top window will remain the active VOR frequency. H will be annunciated on the bottom line, indicating that the DME frequency is holding with the active frequency which is displayed on the top line. The bottom line will be labeled DME and will display the active frequency shown in VHF (VOR) format. The DME may then be tuned by pressing the line select key and changing it to a new channel. Pressing the DME button again will cause the DME (lower) window to change to a TACAN channel presentation. TACAN channels, along with their related W, X, Y, and Z channelization nomenclature will then be tunable with the tuning knobs. The DME function of all 126 TACAN channels may be tuned. No azimuth information is received in this mode. A third press of the DME button causes the NAV window to return to its normal active/preset presentation and the DME will resume tuning with the active frequency.

DME information is displayed on the pilot and copilot EHSIs by pressing the NAV button on the DC-550 display controller. Pressing the NAV button alternately selects NAV 1 and NAV 2 for display. If both NAV receivers are selected to the same NAV source, the NAV annunciations (VOR 1, VOR 2) on the EHSI will be in amber. The selected DME will always be the same as the NAV source (VOR). If no DME information is available, the DME readout will display amber dashes.

HONEYWELL PRIMUS® II RADIO SYSTEM—AUXILIARY COM 1/NAV 2 CDU (OPTIONAL)

The CD-850 CDH is an alternate or emergency backup capability for tuning the No. 1 VHF COM module and the No. 1 VHF NAV receiver module (Figure 16-52). This is done on private line data buses that remain operational in the event the primary radio system bus (RSB) tuning is not available or if the pilot/operator wishes to override the bus tuning for any reason. The CDH listens on the RSB and displays the active frequencies of these two modules.

Figure 16-52. Auxiliary COM 1/NAV 2 Control Display Unit

The CDH uses a transflective, dichroic (black dye) LCD to supply enhanced readability and reliability. The panel lettering and buttons are internally lit using aviation blue-white lighting.

The normal and emergency modes are submodes selected by the mode key. The following describe each control and annunciator on the CDH:

System installation annunciator—Annunciates the radio system (1,2, or 3) indicating to which system the CDH is connected. In the Citation Ultra, the No. 1 annunciator is ON indicating the CDH is connected to the No. 1 COM and No. 1 NAV.

Remote tune annunciator—This annunciator is inactive in the Citation Ultra.

Tuning cursor—Annunciator is a lit triangle controlled by the transfer key. It indicates which frequency can be changed by the tuning knobs.

NAV AUDIO ON annunciator—Annunciator indicates the NAV audio is selected ON.

Emergency (EMERG) mode annunciator—Annunciator indicates the CDH is placed in the

emergency backup mode that locks out all other COM and NAV tuning sources for the No. 1 COM and No. 1 NAV. The No. 1 COM and No. 1 NAV are tuned exclusively by the CDH. This annunciator is not related to the emergency frequency of 121.5 MHz.

Squelch annunciator—Indicates the squelch is opened by the SQ ON–OFF switch.

Transmit (TX) annunciator—Annunciator indicates the COM transmitter is ON.

NAV AUDIO ON–OFF switch—Alternate action button used to toggle NAV and audio ON or OFF.

Squelch (SQ) ON–OFF switch—Alternate action button used to toggle COM squelch ON or OFF.

Tuning knobs—The knobs change the frequency indicated by the tuning cursor. Large knob adjusts the left two numbers and the small knob adjusts the right two numbers.

Normal/Emergency mode switch—The rotary switch knob gives alternate selection of the normal and emergency modes.

Transfer key—The transfer key alternately selects either the COM frequency (top) or the NAV frequency (bottom) to be connected to the tuning knobs.

Radio tuning annunciators—Annunciators COM and NAV are annunciated individually, together with the tuning cursor, to identify the frequency at the top and bottom lines.

HONEYWELL PRIMUS® II REMOTE RADIO SYSTEM—AUDIO CONTROL UNIT (OPTIONAL)

Two Honeywell Primus® II digital audio control units are supplied with the Honeywell Primus® II remote radio system. Digital transmission of audio from remote units to the audio panels differs from conventional audio systems in that it requires one twisted pair of wires rather than many twisted pairs to achieve the same performance.

The panels have three rows of combination audio ON-OFF switches and volume controls (Figure 16-53). The small round knobs serve as audio on-off switches when pressed. When the switch is latched in, the audio for the particular receiver it serves will be off. When pressed again, the switch will move outward turning the audio on. When the audio is on, the knob of the switch may be used as a volume control. Turning it clockwise will increase the volume; counterclockwise will decrease it.

Figure 16-53. Primus® II Audio Control Panel

Two larger knobs on the lower part of the control panel serve as volume controls for the pilot/copilot speaker and headset respectively. These knobs are in series with the smaller individual volume controls. This allows a volume selection to be made on the individual radio volume control, and then a final overall selection to be made by means of the speaker or headphone control, resulting in a more flexible individual control of all available audio signals.

A row of microphone selector buttons (push-push latching switches) is across the top of the control panel. These buttons connect the pilot or copilot microphone to the selected transmitter. The receiver for the selected radio or interphone will also be selected regardless of the

audio on-off switches selection. For night operation, a light above the microphone selector button is illuminated.

When depressed, the emergency COM (EMER) microphone switch, at the upper right corner of the audio panel, connects COM 1 transceiver directly to the aircraft microphone and headphone. All electronic circuitry is eliminated and all other audio panel modes are disabled in this mode. NAV 2 audio will also be directed into the headset controlled by the panel on which EMER is activated, if NAV AUDIO is selected on the CDU.

PULSE EQUIPMENT

TRANSPONDERS

Two Collins TDR-94 transponders, each with 4096 mode A code capability, are installed in the nose avionics compartment. The transponders (No. 1 and No. 2) have automatic altitude reporting (Mode C) capability, which is provided electronically to the transponders by the respective side AZ-840 micro air data computer. The two transponders are controlled by a CTL-92 control on the right side of the center instrument panel. A switch on the control determines which transponder and altitude source is selected for operation.

CTL-92 Transponder Control Panel

The CTL-92 (see Figure 16-43) uses a digital readout to display the pilot-selected transponder code. Power and mode of operation are controlled by the power and mode switch, which has OFF, STBY, ON, and ALT positions. STBY applies power to the system for warmup and allows momentary power interruptions, which may be desired without having to turn the system OFF. In ON, the transmitter is enabled for normal operation. The ALT position causes transmission of uncorrected barometric altitude, which is supplied by the respective AZ-840 micro air data computer. The green XPDR ENC ALT PRI/SEC switch (see Figure 16-25) is used to select between the No. 1 and No. 2 transponders.

Two concentric knobs are used to set the code. During normal operation, the upper window displays the selected code, and the lower window is blank. The lower window is active only during self-test. The TEST button initiates a system self-test. To test the system, select the desired transponder, turn the system ON, and press the TEST button. The active code is displayed in maximum intensity, and if the system is operating properly, ALT is displayed along with the altitude in thousands of feet (5.0 for 5,000 feet) in the upper window.

An IDENT button is on the front of the transponder control and one on each control wheel. Any of the three activates the IDENT circuit. The IDENT button causes a distinctive return to appear on a ground controller radar for 30 seconds after the IDENT button is pressed and released. It should not be depressed unless requested by a ground controller. The PRE button is used to select a preset code for storage. The button is pressed in and held while the selector knob is turned to select a code to be stored. Momentarily pressing the PRE button recalls the stored code.

When codes are being changed, an ACT annunciation flashes in the display. If ACT flashes, the code being transmitted is not identical to the one being displayed. An annunciation of TX is displayed each time the transponder replies to an interrogation. If the transponder malfunctions, diagnostic message codes are displayed in the upper window.

DISTANCE MEASURING EQUIPMENT (DME)

The standard DME installation consists of two DME-442 receiver-transmitters and two IND-42C indicators. The IND-42C (Figure 16-54) is an indicator only and does not control selection of DME data for any purpose other than selection of the data to be displayed on the indicator. NAV 1 is permanently connected to the pilot

Figure 16-54. DME Indicator

DME-422 indicator, and NAV 2 is permanently connected to the copilot DME-442 indicator.

DME information is displayed on the pilot and copilot EHSIs by pressing the NAV button on the DC-550 EFIS display controller (see Figure 16-10). Pressing the NAV button alternately selects NAV 1 and NAV 2 for display on the respective EFIS. If both NAV sources (VOR) are displayed and annunciated on the EFIS, the display will always be the same as the DME selected by means of the NAV button on the display controller. Selections made on the IND-42C indicator have no bearing on the EFIS display.

The power switch (PWR) controls power to the indicator and to the DME-442 receiver-transmitter. The mode selector switch (SEL) is a nonlatching pushbutton switch which selects the information to be displayed in the alphanumeric (right) digital display. When initially powered up, the alphanumeric display shows ID (DME station identifier). Pressing the SEL switch sequentially selects KT (knots), MN (minutes to station), and ID. An NM (nautical miles) display is continually shown on the numeric (left) digital display. The annunciators 1, 2, NM, HLD (hold), KT, MIN, and ID are present when the respective selection is made in order to identify the digital data presented and the source of the data.

If the pilot desires to retune the NAV control to which the DME indicator is selected, but to retain the DME readout of the present station, HLD is selected on the respective NAV control before the set is retuned (see Figure 16-43). The DME holds on the previously tuned frequency, and HLD is annunciated on the IND-42C indicator. An amber H is also annunciated to the left of the distance display on the PFD EHSI presentation to indicate the DME frequency is being held.

The DME-442 system is self-tested by pressing the TEST button on a NAV receiver. Upon initiation of self-test, all display segments and annunciators on the IND-42C indicator illuminate for a lamp test. If NM and ID were selected for display, the numeric display shows 100 NM. If KT was selected for display, the alphanumeric display shows 100 KT. If MIN was selected for display, 60 MIN is displayed. At the completion of the test routine, AOK appears in the alphanumeric display if no faults were detected. AOK will also be heard over the DME aural output. The IND-42C displays then return to normal. If a fault is detected, the word DIAG and a self-test fault code is displayed. A list of fault codes is found in the Component Maintenance Manual and a partial list in the Collins Pro Line II Pilot Guide 523-0773070-001117, dated January 5, 1987, or later revision.

NOTE

The self-test routine takes approximately ten seconds to complete. For that reason, it should not be attempted during a critical phase of flight.

RADIO ALTIMETER

The Collins ALT-55B radio altimeter displays radio altitude at all times up to an absolute altitude of 2,500 feet. The system becomes operational when the aircraft electrical system is powered up, and it remains operational throughout the flight. Radio altitude is displayed in the bottom center of the attitude sphere in the EADI displays, and on the optional conventional radio altimeter indicator (if installed) on the pilot instrument panel. Other optional installations have the conventional indicator on the copilot instrument panel.

The altitude display in the EADIs operates from -20 to 2,500 feet. Between 200 and 2,500 feet, the display is in ten-foot increments. Below 200 feet, it is in 5-foot increments. Above 2,500 feet, the display disappears.

Decision height (DH) selection is displayed digitally in the lower right side of the EADI display. It is selected by means of the DH/TST knob on the DC-550 display controller (see Figure 16-10). The EADI decision height range is from 0 to 990 feet in 10-foot increments. Full counterclockwise rotation of the DH/TST knob on the DC-550 display controller removes the DH display. A decision height warning horn sounds when the aircraft reaches the decision height set on the pilot EADI. The tone fades as the aircraft descends through the altitude.

The decision height warning horn is controlled only by the DH setting in the pilot EADI. The copilot EADI decision height selection has no effect on the sounding of the DH warning horn. The decision height index on the optional conventional indicator controls only the DH light on the top of the indicator. When the aircraft descends below an altitude of 100 feet above selected decision height, a white box appears in the upper left side of the EADI. When the decision height is reached, an amber DH appears inside the box. The display flashes for ten seconds and then goes steady.

A low altitude awareness display, which is a brown strip along the right side of the PFD, is used as a visual annunciation of the aircraft nearness to the ground. The low altitude awareness display is inside the bottom part of the altitude display and begins to appear when an altitude of less than 550 feet is reached. At touchdown, the low altitude awareness display reaches the horizon line.

If radio altimeter information is invalid, the radio altitude display will be amber dashes.

Functional testing of the radio altimeter system and the EADI display digital readout is accomplished on the ground by depressing the TEST button on the DC-550 display controller. The following displays occur: a radio altitude of 50 ± 5 feet is indicated until the button is released, at which time the actual altitude is displayed. The decision height window displays dashes when the TEST button is held down and then displays the current set altitude for the remainder of the test. The radio altimeter TEST cannot be accomplished when the APR CAP function of the flight director is in operation. The horn check depends on the DH altitude set on the pilot EADI display.

WEATHER RADAR—PRIMUS® 650 COLORADAR

The Primus® 650 ColoRadar system is an X-band alphanumeric digital radar with a display designed for weather location and ground mapping. The system can be operated in conjunction with the EFIS and the MFD equipment to provide radar video displays. Storm intensity is displayed at five color levels, with black representing weak or no returns and green, yellow, red, and magenta showing progressively stronger returns. In the ground mapping mode, levels of returns are displayed as black, cyan, yellow, and magenta. The system consists of a receiver-transmitter antenna in the nose section and a controller. Some functions of the MFD system and the EFIS interface with the radar. Consult the Aircraft Operating Manual and vendor handbooks for operating instructions.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEMS (TCAS) (OPTIONAL)

TCAS I

The optional traffic alert and collision avoidance system (TCAS) receives air data information from the AZ-850 Air DATA System (ADS). Heading data is supplied by the directional gyro. TCAS supplies the electronic display system with selected air traffic and conflict avoidance information. The optional TCAS I system is an onboard collision avoidance and traffic display system with computer processing to identify and display potential and predicted collision

targets. The system is compatible with and independent of the air traffic control system. The TCAS I system, from transponder replies, determines the relative altitude, range, and bearing of any aircraft equipped with a mode C or S transponder, and determines the threat posed by such traffic. Aircraft with only mode A transponders will not provide altitude information; however, TCAS I will issue traffic advisories. TCAS I cannot detect aircraft without operating transponders.

The TCAS I is a single-system installation consisting of one TCAS I processor, one top-mounted bearing antenna, one bottom-mounted bearing antenna, and traffic advisory displays on the MFD. Aural alerts are available through the headphones and individual pilot and copilot speakers. System control is provided through the CP66A control panel (Figure 16-55). The TA display is informative only, displaying area traffic without attempting to provide any form of conflict resolution.

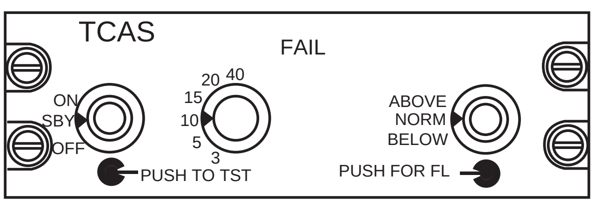


Figure 16-55. TCAS I Control Panel

If traffic gets to within 15 to 30 seconds of a projected closest point of approach (CPA) and/or meets other range and closure criteria, it is then considered a potential threat, and an aural and visual traffic advisory is issued. This level advisory calls attention to a potential collision threat using the traffic advisory display and voice message, Traffic traffic. It assists the pilot in achieving visual acquisition of the threat traffic.

TCAS I is intended as an aid to the see-and-avoid concept (Figure 16-56). Once an intruder is visually acquired, it is the pilot responsibility to maneuver as necessary to maintain safe separation.

Figure 16-56. MFD with Map Mode Display and Optional TCAS I

For specific operating instructions consult the Airplane Flight Manual (AFM) Supplement 10, Section III of the Aircraft Operating Manual, and Bendix/King CAS66A TCAS I Pilot Guide.

TCAS II

TCAS II detects and tracks aircraft in the vicinity of your own aircraft. It interrogates the transponders of other aircraft and analyzes the signals to determine range and bearing, and relative altitude if it is being reported. It then issues visual and aural advisories so that crew may perform appropriate vertical avoidance maneuvers. The following information is generated and considered by the TCAS II in making a decision as to whether an aircraft which returns a signal constitutes a threat or not: range between your aircraft and the intruder, relative bearing of the intruder, altitude and vertical speed of the intruder (if it is reporting

altitude), and the closing rate between your aircraft and the intruder.

TCAS II is an independent airborne system. It is designed to act as a backup to the Air Traffic Control system and the see-and-avoid concept. TCAS consists of six aircraft-mounted antennas, a TCAS computer unit, and dual Mode S transponders; displays and controls are in the cockpit. The following options are operational:

- The TCAS is wired to display all traffic full time.
- The TCAS display range is pilot-selectable.
- The TCAS system will automatically be in TA ONLY and not in standby when on the ground (and the TCAS system is active). Pilot-selectable self-test is not inhibited in flight.
- TA/VSI test pattern is displayed during the pilot-initiated TCAS II self-test.
- A separate TA/VSI lamp test is not available.

TCAS has a surveillance volume defined by a minimum horizontal radius of 14 nautical miles and a minimum vertical range of ±12,700 feet. TCAS continually surveys the airspace around an aircraft, seeking replies from other aircraft in the vicinity via their ATC transponders. The transponder replies are tracked by the TCAS system. Flight paths are predicted based upon these tracks. Flight paths predicted to penetrate a collision area surrounding the TCAS aircraft are annunciated by TCAS.

TCAS generates two types of annunciations: a Traffic Advisory (TA) and a Resolution Advisory (RA). The airspace around the TCAS aircraft can be divided into caution and warning areas. The physical dimensions of these areas are time-based and vary as a function of horizontal and vertical closure speed and distance from an intruder aircraft.

The TA display identifies the relative threat of each aircraft which could present a traffic conflict (intruder), by using various symbols and colors. TCAS II also provides several appropriate synthesized voice announcements which are used to alert traffic and to notify them of a recommended avoidance action. The TCAS II system is compatible with both current and planned ATC systems and operates independently of them. It has the capability to monitor two or more TCAS II-equipped aircraft by means of their mode S transponders and to coordinate their maneuvers.

The two types of cockpit display are the Resolution Advisory (RA) and Traffic Advisory (TA). The RA display is incorporated into the vertical speed indicator (VSI) display on the primary flight display (PFD). By illuminating red and green arcs around the display dial, it presents the required rate or limitation of climb or descent to avoid a possible collision. The resolution advisory (RA) is based on the expectation that the crew will comply within 5 seconds. The system requires 2 1/2 seconds to show an increase or a reversal to an RA, In order for the system to generate an RA, the intruder must be reporting altitude; if an altitude is not being reported, the advisory will be limited to a TA. The TA display shows the intruding aircraft relative position and altitude, with a trend arrow to indicate if it is climbing or descending at greater than 500 feet per minute. This display is provided at the bottom area of the MFD, which is reserved for TCAS presentation when TCAS is selected for display (Figure 16-57).

Normally a TA precedes an RA by 15 seconds if an RA is going to ensue from the computation of closure rate, heading, rate-of-climb/descent, etc., of the intruder. Depending upon altitude, the system presents a traffic alert display, accompanied by an aural Traffic traffic, when the time to the closest point of approach is between 35 and 45 seconds. The crew should attempt to gain visual contact with the intruder and be prepared to maneuver. The crew should take no evasive action based solely on the TCAS II traffic display.

TCAS II can track as many as 45 aircraft at one time and display up to 30 of them. It can coordinate a resolution advisory for as many as three intruders at one time. The advisories are

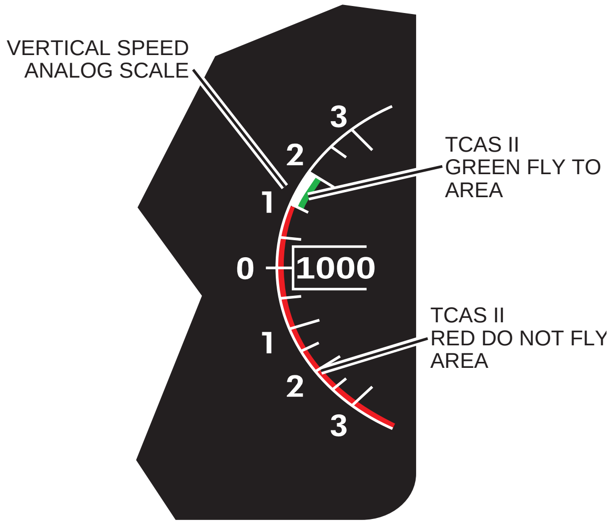


Figure 16-57. TCAS II Display

always generated considering the least required amount of deviation from the flight while providing a safe vertical separation.

TCAS II does not replace ATC procedures and the existing see-and-avoid concept; however, if ATC communications are temporarily lost, TCAS II adds a significant backup capability for collision avoidance, and can also enhance safety of flight in crowded terminal areas, under both VFR and IFR conditions.

TCAS continuously calculates tracked aircraft projected positions. TAs and RAs are therefore constantly updated and provide real-time advisory and position information.

Once the flight path of the intruder no longer conflicts with the collision area of the TCAS aircraft, TCAS announces Clear of conflict. The flight crew should then return to the original clearance profile.

TCAS generates TAs and RAs against intruder aircraft with ATC transponders replying in Mode C and Mode S. TCAS requires altitude information from intruder aircraft to generate RAs. TCAS can provide only TAs for intruder aircraft whose transponders reply in Mode A (non altitude reporting).

NOTE

For single engine operations, select TA only.

CAUTION

TCAS cannot provide an alert for traffic conflicts with aircraft without operating transponders.

If an installation includes a windshear warning system and/or a ground proximity warning system, in conjunction with the TCAS II system, the aural warning priority is as follows:

1. Windshear warning
2. Ground proximity warning
3. TCAS II warning

For specific operating instructions consult the *AFM* Supplement 43, Section III of the *Aircraft Operating Manual*, and *Bendix/King CAS81A TCAS II Pilot Manual*.

MARK VI SUNDSTRAND GROUND PROXIMITY WARNING SYSTEM (GPWS) (OPTIONAL)

The Mark VI Sundstrand ground proximity warning system (GPWS) provides visual and aural warnings of terrain in six flight modes:

- Excessive rate of descent with respect to the terrain
- Excessive closure rates to terrain
- Negative climb before acquiring a predetermined terrain clearance after takeoff or a missed approach
- Insufficient terrain clearance based on flap configuration• Inadvertent descent below glide slope
- Inadvertent descent below minimum descent altitude

Aircraft equipped with the optional GPWS have a red PULL UP and amber BELOW G/S and G/S CANCELED annunciators directly adjacent to each PFD (Figure 16-58). The red PULL UP light illuminates concurrently with the aural Pull up warning if any of the six terrain proximity mode windows is entered as noted above. During ILS glide-slope approaches, the below-glide-slope warning may be canceled if desired (runway in sight and deliberately flying below glide slope for landing) by depressing the BELOW G/S switchlight and illuminating the lower half labeled G/S CANCELED.

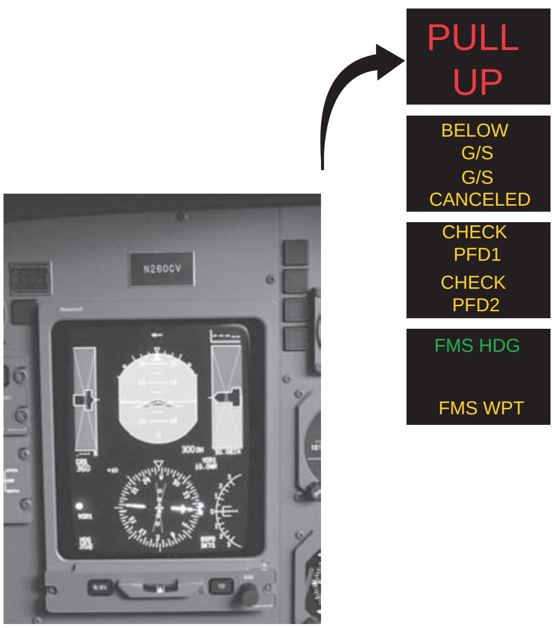


Figure 16-58. PFD Annunciator Strip Lights

The bottom two light buttons of the pushbutton/annunciator strip lights adjacent to the MFD (see Figure 16-25) are dedicated to the GPWS. The switchlight labeled GPWS FLAP OVRD/ACTIVE is provided to disable the flap configuration input to prevent nuisance warnings when landing with less than full flaps (aural and visual warnings would normally be initiated at 200 feet with less than full flaps). The lower GPWS TEST/GPWS INOP lights are provided to perform functional tests and provide indication of system malfunctions. The visual and aural warnings are initiated as the rotary test switch is positioned to ANNU.

AREA NAVIGATION

FLIGHT MANAGEMENT SYSTEM

The GNS-X/ES FMS is a comprehensive navigation management system that integrates multiple systems and sensors into a total package capable of precise navigation and aircraft performance computations. The system uses information from various navigation sources, including DME, VOR, GPS, its own integral LORAN-C, and optional VLF/OMEGA, if installed. It alerts the flight crew to any irregularities such as the loss of enough sensors to compute a valid position. If the loss of a sensor over a predetermined length of time occurs, the system enters a dead reckoning (DR) mode and informs the pilot on the CDU.

The GNS-X/ES provides steering information to the pilot through the IC-600 integrated display guidance computer and primary flight display (PFD). When connected to the autopilot, it provides roll steering commands. The NAV computer additionally computes fuel flow information, providing current fuel status and aircraft gross weight throughout the flight if the fuel and gross weight are updated prior to takeoff. The system also provides active flight plan data to be displayed on the PFD or the MFD tubes.

The following components comprise the GNS-X/ES system: a control display unit (CDU) which houses its own LORAN-C, a global positioning system (GPS)(six-channel), a configuration module unit, an antenna, and an optional VLF/OMEGA sensor, which is called the receiver processing unit (RPU) (if installed).

The CDU is the heart of the system, possessing the computer, the VORTAC positioning unit (VPU), the navigation data bank (NDB), and the memory capability, as well as the LORAN-C sensor and the GPS receiver. The NDB contains more than 80,000 navigation

points in its data base, as well as 999 operator-generated waypoints; 56 flight plans with up to 50 waypoints each may be stored. The NAV data base must be updated every 28 days by means of a data transfer unit (DTU) or portable DTU. The connection for the DTU is in the forward end of the center pedestal.

The FMS supplies waypoint (WPT) information to the IC-600 display guidance computer for use in micro air data computer vertical navigation (VNAV) computations, which are displayed on the multifunction display (MFD). An advisory vertical navigation capability is also provided through the GNS-X/ES CDU. Vertical waypoints may be programmed and viewed on the CDU and used as indicators for climb and descent points. The altitude changes may be programmed both with and without vertical path angles. The FMS VNAV function will not couple to the autopilot/flight director.

The CDU provides the pilot interface with the system. It has a compact full-alpha keyboard with a color cathode ray tube (CRT) to provide system readouts and to accept pilot inputs into the system (Figure 16-59).

The GNS-X/ES Operator Manual, Report No. 1425 with latest revisions must be available to the flight crew whenever navigation is predicated on GNS-X.

AUTOTUNE ANNUNCIATORS/SWITCHES

NAV 1 TUNE/AUTOTUNE ENABLED and NAV 2 TUNE/AUTOTUNE ENABLED switchlights on the center instrument panel can be used to control autotuning of the NAV receivers by the GNS-X (see Figure 16-25). Pressing the switches alternately selects and deselects autotuning capability. If the switchlights are illuminated, the FMS may autotune the NAV 1 and/or NAV 2 if needed for navigation. If the NAVs have been channeled manually, the GNS-X/ES will not autotune until the switch is pressed. If NAV 1 and/or NAV 2 is selected on the EFIS, it will not autotune.

Figure 16-59. GNS-X/ES Control Display Unit (CDU)

CAUTION

Exercise caution that unanticipated autotuning of the NAVs does not occur when the GNS-X/ES is operating. Autotuning is evidenced by an automatic change of frequency in the NAV receiver control heads.

NOTE

The AUTOTUNE ENABLED functions are disabled on early Citation V Ultra aircraft.

For specific operating procedures and operating limitations consult the *AFM* Supplement 2, Section III of the *Aircraft Operating Manual*, and the *Allied Signal/Global Wulfsberg Systems GNS-X/ES Operator Manual*.

Optional equipment includes the GNS-XLS CDU shown in Figure 16-60.

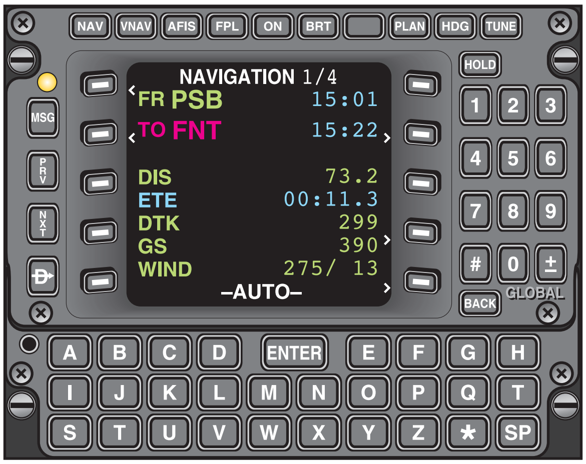


Figure 16-60. GNS-XLS CDU (Optional)

GLOBAL AIRBORNE FLIGHT INFORMATION SYSTEM (AFIS) (OPTIONAL)

The Global Airborne Flight Information System (AFIS) interfaces the flight planning and performance management functions of the standard GNS-X Flight Management System with Global Data Center computers by means of the Aircraft Communication Addressing and Reporting System (ACARS). ACARS provides the computer data link between the aircraft and the Global Data Center by which transfer of digital data concerning flight plans, weather, and message traffic is possible.

The Model 560 ULTRA AFIS installation consists of a data management unit (DMU), a configuration module, an optional data transfer unit (DTU), and an antenna. The Global Data Center and ACARS, with its VHF/ ground telephone system interface, make up the ground portion of the system. The Global Data System provides the services of flight planning, aviation, weather, and flight-related message forwarding through its mainframe computers, which accept and process digital data and provide the requested information on a real-time basis.

The optional AFIS equipment consists of the following:

- Data transfer unit (DTU) contains a 3.5-inch micro floppy disk drive mounted in the cockpit.
- Data management unit (DMU) computer formats the disk information and presents it to the GNS-X/ES FMC for display on the CDU. The DMU contains a VHF transceiver using an external VHF antenna to transmit and receive data from an appropriate ground station onto the Global Data Center while in flight.
- Global Personal Computer (GPC) and printer permits accessing the GDC via telephone modem and storing the information on the floppy disk.

PITOT-STATIC SYSTEM

The Citation V ULTRA is equipped with three separate and independent pitot-static systems (Figure 16-61). The two primary systems serve the pilot and copilot systems. The third (backup) or standby system provides pitot and static air pressure to the standby airspeed altimeter/indicator on the center instrument panel and to the landing gear warning horn pressure switch, and it provides a source of static pressure for the cabin pressure differential pressure gauge.

PITOT TUBES

Pitot pressure from the tube mounted on the left nose of the aircraft (Figure 16-62) supplies

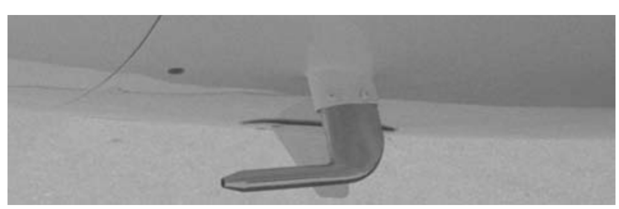


Figure 16-62. Pitot Tube

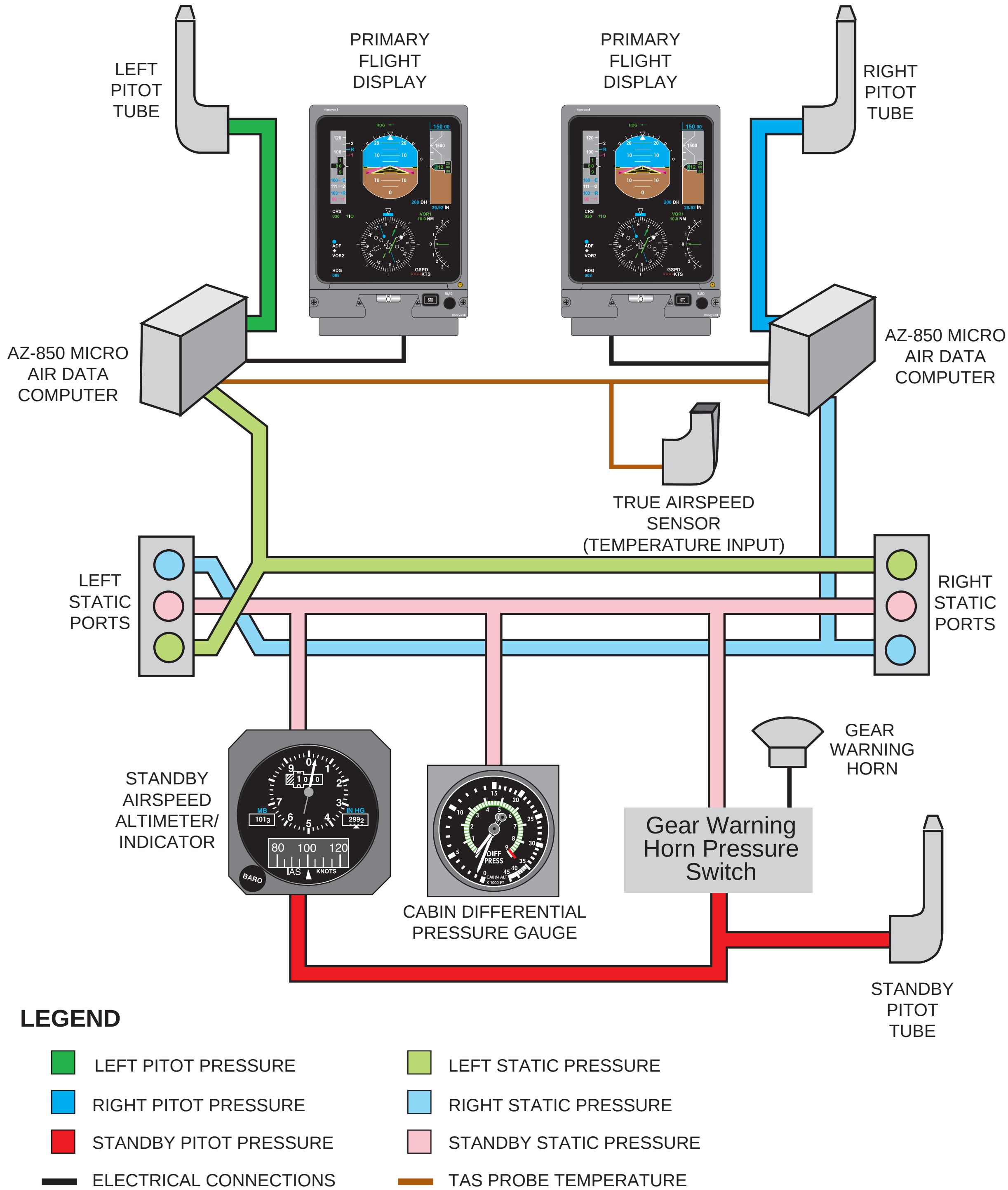


Figure 16-61. Pitot-Static System

pressure to the pilot AZ-840 micro air data computer which, after converting the information into digital information, forwards the data to the pilot primary flight display (PFD). The pitot tube on the right nose of the aircraft serves the same function in the copilot system.

The pitot tube on the right side of the fuselage, below and forward of the emergency exit hatch, provides pitot pressure to the standby airspeed altimeter/indicator and the landing gear warning horn pressure switch.

STATIC PORTS

Three static ports are on each side of the aircraft (Figure 16-63). The lower port on the left side and the upper port on the right side provide the static source for the pilot system. The upper port on the left side and the lower port on the right side provide the static source for the copilot system. The center ports on each side provide static pressure for the standby pitot-static system.

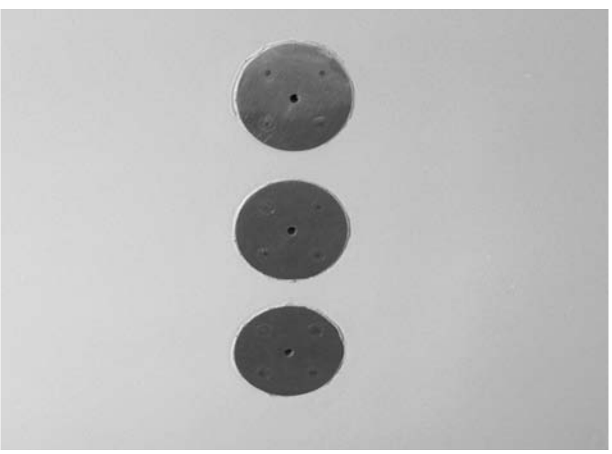


Figure 16-63. Static Ports

ANTI-ICE PROTECTION

All pitot tubes and static ports are heated and controlled by the PITOT and STATIC switch on the pilot switch panel (refer to Chapter 10—"Ice and Rain Protection").

The pilot and copilot pitot-static anti-ice systems are powered from the main DC system through the LH PITOT STATIC and RH PITOT STATIC circuit breakers on the pilot CB panel. The backup (standby) pitot-static anti-ice system is powered from the emergency DC system through the STBY P/S HTR/VIB circuit breaker on the pilot CB panel. This circuit breaker also provides power to an electric motor to constantly vibrate the standby airspeed/altimeter instrument to ensure accuracy due to the low vibration level in turbojet aircraft.

STATIC DISCHARGE WICKS

A static electrical charge, commonly referred to as P (precipitation) static, builds up on the surface of an aircraft while in flight and causes interference in radio and avionics equipment operation. The static wicks are installed on all trailing edges (Figure 16-64) and dissipate the static electricity in flight.

NOTE

Do not wax the aircraft with products containing silicones. They can contribute to P-static buildup, especially if the surfaces are buffed to produce a shine.

Figure 16-64. Static Wicks (Typical)

There are a total of 19 static wicks:

- One on each wingtip
- Two on each wing trailing edge outboard of the aileron
- Two on the trailing edge of each aileron
- Two on the trailing edge of each elevator
- Two on the upper trailing edge of the rudder
- One on the top of the rudder
- One on top of the vertical fin
- One on the tail stinger

NOTE

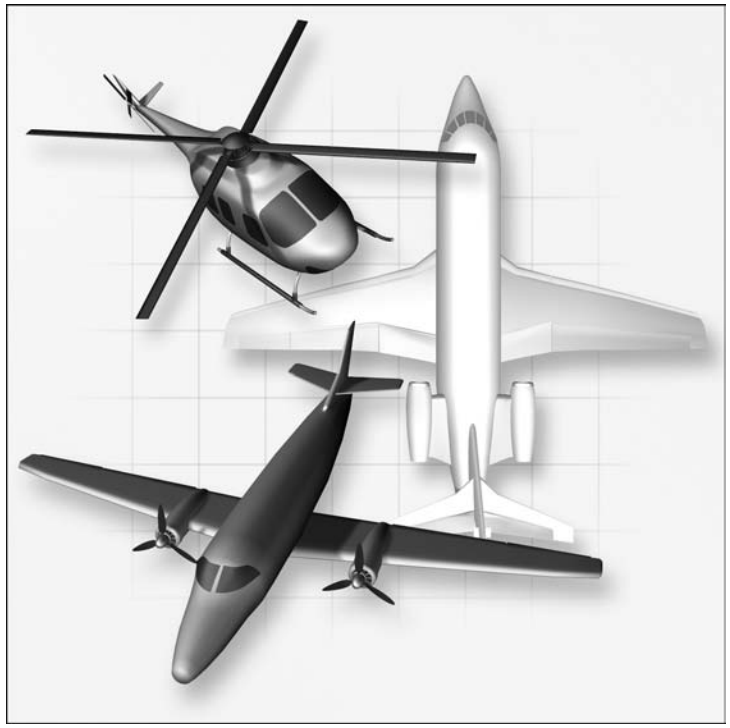
Maximum of three static wick missing from entire airframe, and no two missing consecutively. All four elevator static wicks must be installed.

CHAPTER 17
MISCELLANEOUS SYSTEMS

ILLUSTRATIONS

TABLES

CHAPTER 17
MISCELLANEOUS SYSTEMS



INTRODUCTION

This chapter covers the oxygen system installed on the Citation V Ultra aircraft. Oxygen is supplied to the crew and passengers during pressurization system malfunctions, or whenever required.

GENERAL

The oxygen system consists of the crew and passenger distribution systems. Oxygen is available to the crew at all times and can be made available to the passengers either automatically above a predetermined cabin altitude, or manually at any altitude by a cockpit control. The system is primarily intended to provide emergency oxygen since a cabin altitude of 8,000 feet is normally maintained by the pressurization system up to the maximum certified altitude.

The system consists of an oxygen storage cylinder with an integral shutoff valve and pressure regulator, servicing fitting, crew and passenger masks, altitude pressure switch, overboard discharge disc, and a control selector on the pilot console.

DESCRIPTION

OXYGEN CYLINDER ASSEMBLY

The oxygen cylinder installed in the right side of the lower nose compartment has a 64-cubic-foot (1,812 liter) capacity. A shutoff valve and pressure regulator on the cylinder control the flow of oxygen to the distribution system. The shutoff valve is normally open; the regulator reduces line pressure to 70 psi. The cylinder is serviced through the filler port in the lower aft sill of the right nose baggage compartment door with aviators' breathing oxygen (MIL-0-27210).

PRESSURE GAUGE

A direct-reading oxygen pressure gauge is on the right side of the copilot instrument panel (Figure 17-1). The gauge reads cylinder pressure anytime the system is charged, regardless of the positions of the shutoff valve on the cylinder. The fully serviced system should read 1,600–1,800 psi. Gauge markings are listed in the Limitations section of this manual.

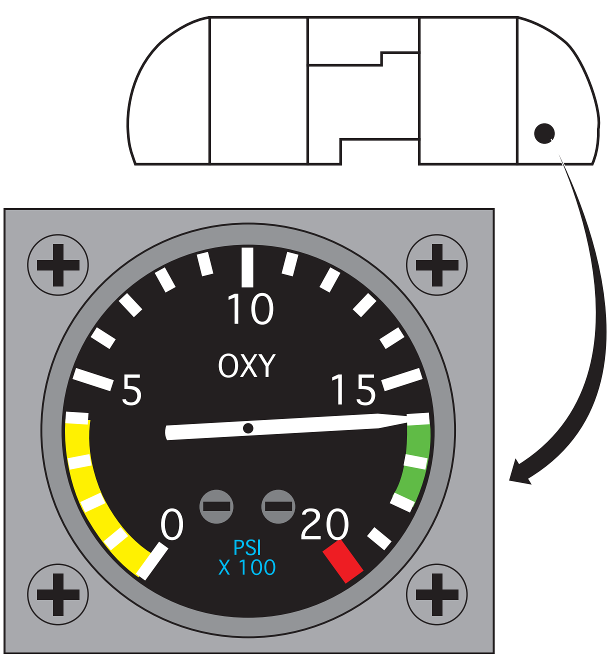


Figure 17-1. Oxygen Pressure Gauge

Figure 17-2 provides information for dispatch with less than full oxygen bottle. The following assumptions (unless otherwise noted) apply to Figure 17-2 and are factored into available time calculations:

- Oxygen consumed during a 10 minute emergency descent fro FL450 to 10,000 feet MSL. This defines the starting point of each bottle pressure vs. available time plot.
- After the emergency descent, the cabin altitude for the remainder of the flight is between FL250 and 10,000 feet MSL/
- All pilot and copilot oxygen requirements are included. Crew consumption rate is 20 liters/minute during the emergency descent and 10 liters/minute thereafter.
- Cockpit masks are at 100% setting regardless of cabin altitude.
- Normal pilot usage as required by operating rules when operating above FL350 is not taken into account.

CONTROLS

The oxygen selector on the pilot console controls oxygen flow to the passengers or restricts it to crew use only (Figure 17-3). NORMAL, CREW ONLY, and MANUAL DROP positions mechanically actuate a control valve for distribution as desired.

OVERBOARD DISCHARGE INDICATOR

A green overboard discharge indicator (disc) is below the aft edge of the right nose compartment door (Figure 17-4). The disc provides a visual indication that an over-pressure condition has occurred in the oxygen cylinder and that the bottle is now empty. If the disc is ruptured, maintenance must be performed before flight.

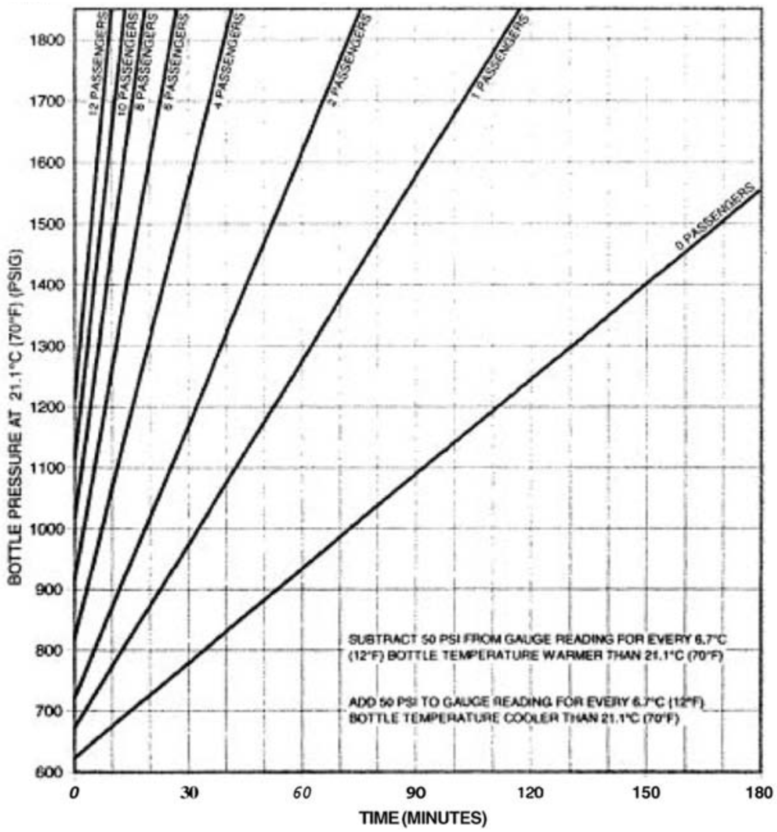


Figure 17-2. Oxygen Duration of 64 Cubic Feet Bottle

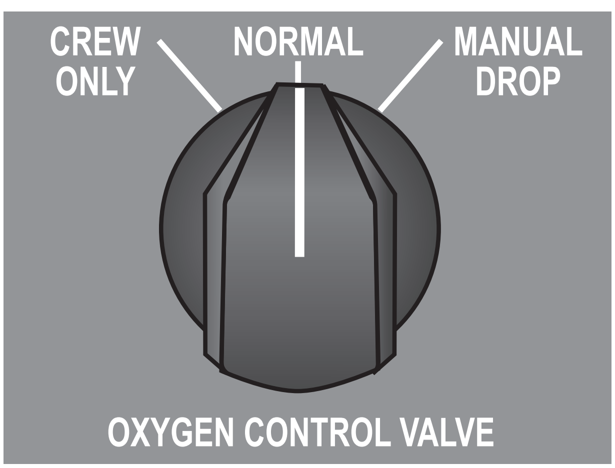


Figure 17-3. Oxygen Selector

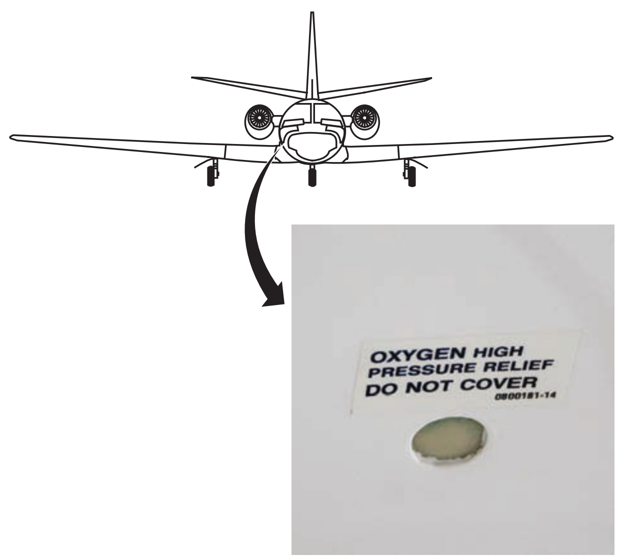


Figure 17-4. Overboard Discharge Indicator

OXYGEN MASKS

The mask is a quick-donning mask with an integral microphone and a regulator with three positions. Selecting the EMER position on the mask regulator makes pressure breathing possible by providing a steady flow to the mask. In the 100% position, the user is assured oxygen is being received when there is no apparent restriction to breathing. The NORM position is for diluter demand. The masks must be stowed in a retainer just aft of each crewmember's side window to qualify as a quick-donning mask (Figure 17-5). When using the mask with fumes or smoke present, select the EMER position.

Figure 17-5. Crew Oxygen Mask

Passenger masks are stowed in overhead containers and can be dropped automatically or manually (Figure 17-6). Oxygen does not flow to the mask until the lanyard is pulled.

OPERATION

With the OXYGEN selector in the NORMAL position, low-pressure oxygen at 70 psi is available to both crewmember through outlets on the side consoles and to the solenoid valve on the oxygen selector (Figure 17-7).

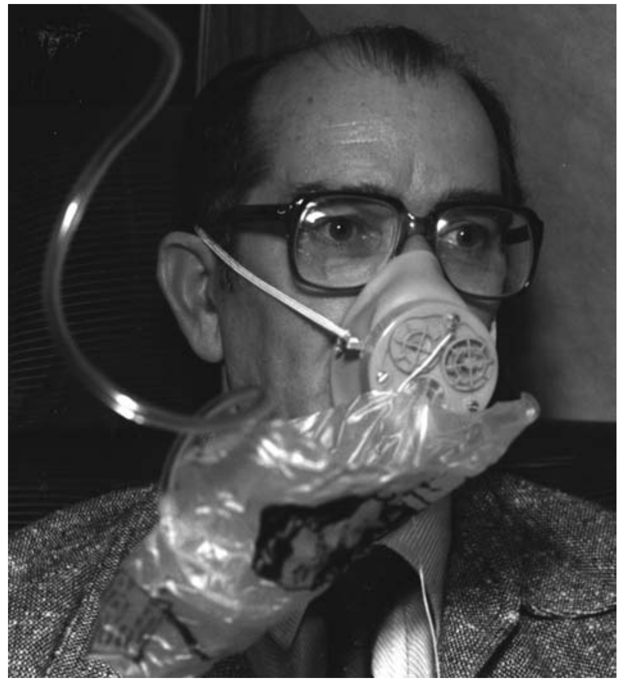


Figure 17-6. Passenger Oxygen Masks

The solenoid valve is normally spring loaded closed, blocking flow to the passenger distribution system. If cabin altitude exceeds 13,500 ± 600 feet, an altitude pressure switch energizes the solenoid valve open. Oxygen flowing into the passenger distribution system releases latches on the mask compartment doors, allowing the doors to open and the masks to fall out. If cabin pressure is restored to normal values, the solenoid valve is deenergized at 8,000 feet cabin altitude, shutting off oxygen flow to the passengers.

If DC power fails, the solenoid valve cannot route oxygen to the passenger system. Placing the OXYGEN selector in MANUAL DROP routes oxygen flow through the manual control valve, dropping the masks as in normal operation.

The CREW ONLY position of the selector blocks flow at the oxygen control valve, shutting off all flow to the passengers. In this position, only the crew has oxygen.

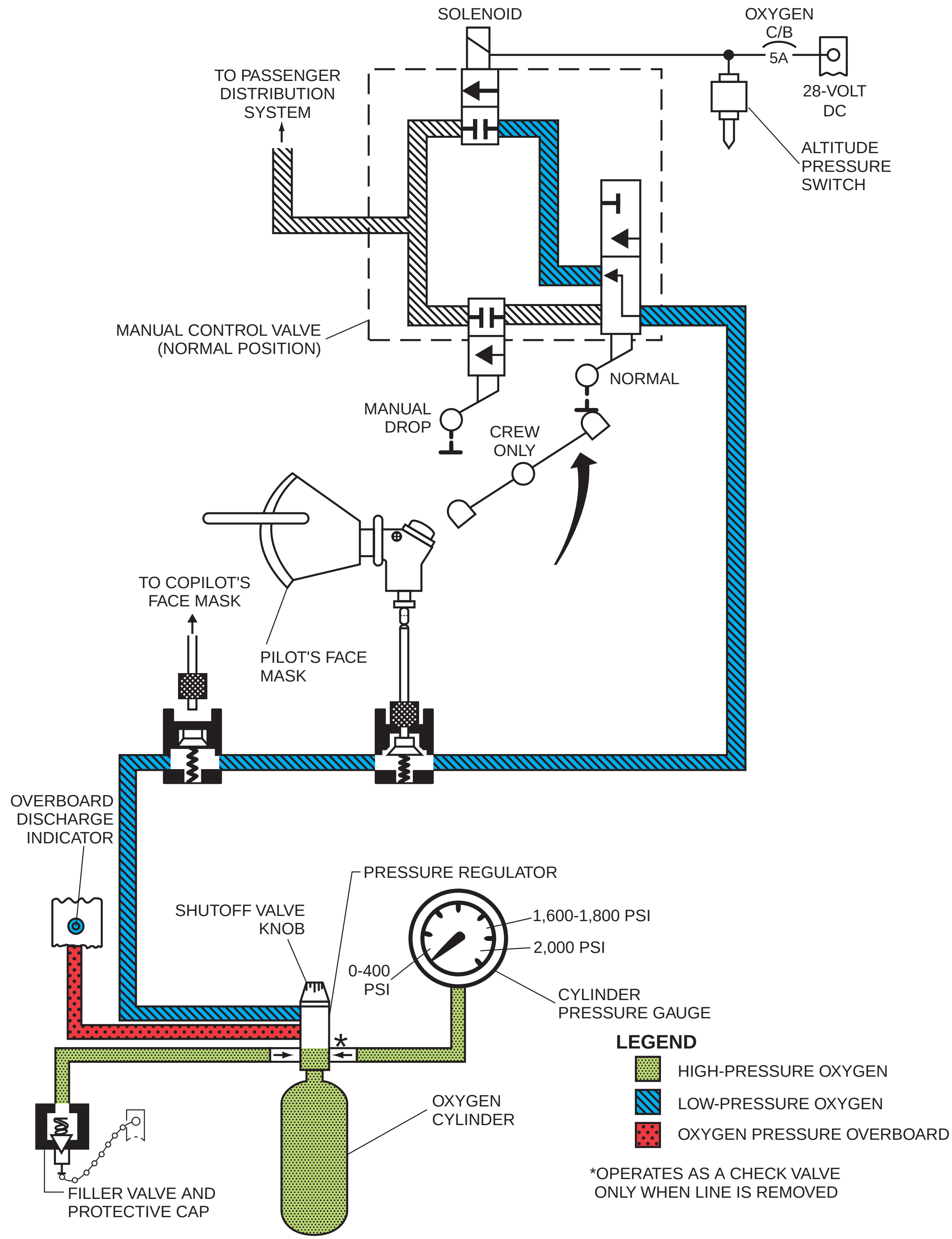


Figure 17-7. Oxygen System

WARNING

No smoking is permitted when using oxygen; oil, grease, soap, lipstick, lip balm and other fatty materials constitute a serious fire hazard when in contact with oxygen.

LIMITATIONS

The pressure demand sweep-on oxygen mask must be properly stowed to qualify as a quick-donning oxygen mask.

NOTE

Headsets, eyeglasses, or hats worn by the crew may interfere with the quick-donning capabilities of the oxygen masks.

Oxygen use limitations are defined by the applicable Federal Aviation Regulations, FAR Part 91.

Table 17-1 depicts the average time of useful consciousness (time from onset of hypoxia until loss of effective performance) at various cabin altitudes.

Table 17-2 depicts oxygen duration for the 64-cubic-foot system.

Table 17-1. AVERAGE TIME OF USEFUL CONSCIOUSNESS

15,000 to 18,000 feet	30 minutes or more
22,000 feet	5 to10 minutes
25,000 feet	3 to 5 minutes
28,000 feet	2 1/2 to 3 minutes
30,000 feet	1 to 2 minutes
35,000 feet	30 to 60 seconds
40,000 feet	15 to 20 seconds
45,000 feet	9 to 15 seconds

WARNING

No smoking when oxygen is being used or following use of passenger oxygen until lanyards have been reinstalled.

Due to human physiological limitations, the passenger oxygen system is not satisfactory for continuous operation above 25,000 feet cabin altitude and the crew oxygen system is not satisfactory for continuous operation above 37,000 feet cabin altitude (above 40,000 feet cabin altitude for EROS masks). Individual physiological limitations may vary. If crew or passengers experience hypoxic symptoms, descend to a lower cabin altitude.

Table 17-2. OXYGEN SUPPLY MASK AND 64 CUBIC-FOOT CYLINDER

AVAILABLE TIME IN MINUTES								
CABIN ALTITUDE	1 COCKPIT	2 COCKPIT	2 COCKPIT 2 CABIN	2 COCKPIT 4 CABIN	2 COCKPIT 6 CABIN	2 COCKPIT 8 CABIN	2 COCKPIT 10 CABIN	2 COCKPIT 11 CABIN
8,000	1,684	842	150	83	57	43	35	32
10,000	1,882	941	154	84	58	44	36	32
15,000	2,000	1,000	159	86	59	45	36	33
20,000	1,455	727	153	85	59	45	37	34
25,000	525	262	113	72	53	42	34	32
30,000	717	359						
34,000	914	457						
35,000	970	485						
37,000	1,103	552						

QUESTIONS

1. The cockpit oxygen pressure gauge reads:

A. The oxygen pressure which is present at the crew masks

B. Electrically derived system low pressure

C. Bottle pressure

D. Electrically derived system high pressure

2. Passenger masks are automatically dropped when the:

A. Oxygen selector is in NORMAL and cabin altitude exceeds 13,500feet.

B. Cabin altitude exceeds 13,500 feet, regardless of oxygen selector position.

C. Oxygen selector is in MANUAL DROP, regardless of altitude.

D. A and C.

3. If DC power fails, placing the oxygen selector in:

A. MANUAL DROP deploys the passenger masks, regardless of the cabin altitude.

B. MANUAL DROP deploys the passenger masks only if 13,500 feet cabin altitude is exceeded.

C. CREW ONLY does not restrict oxygen to the crew only if the cabin altitude is above 13,500 feet.

D. Any of the three operating positions can not route oxygen to the passengers—they have their own oxygen.

4. The purpose of the altitude pressure switch is to:

A. Bypass oxygen flow directly to the passengers regardless of oxygen selector position

B. Open a solenoid at 13,500 feet cabin altitude, allowing oxygen flow to the passenger oxygen distribution system

C. Close a solenoid valve at 13,500 feet cabin altitude, stopping oxygen flow to the passengers

D. Restore cabin altitude to 8,000 feet so that oxygen is not required

5. If the oxygen selector is placed in CREW ONLY:

A. The passenger masks cannot be dropped automatically.

B. The passenger masks does not deploy automatically, but they can still be dropped manually.

C. The passengers still receive oxygen if the cabin altitude is above 8,000 feet.

D. Normal DC power is removed from the passenger mask door actuators, thus preventing them from dropping the masks.

6. If normal DC power is lost with the oxygen selector in NORMAL:

A. The passenger masks deploy immediately, regardless of the cabin altitude.

B. The passenger masks cannot be dropped manually.

C. The oxygen pressure gauge on the copilot panel is inoperative.

D. Automatic dropping of the passenger masks does not occur.

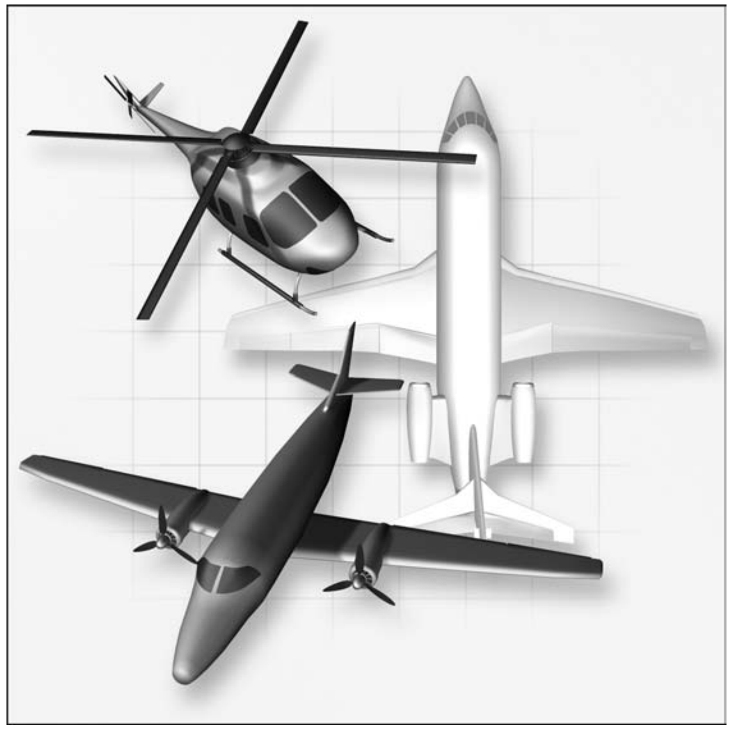
CHAPTER 18
MANEUVERS AND PROCEDURES

CONTENTS

ILLUSTRATIONS

TABLES

CHAPTER 18
MANEUVERS AND PROCEDURES



INTRODUCTION

This chapter contains information and flight profiles likely to be encountered during training and in most daily flight operations. The procedures are consistent with the Citation V Ultra *Airplane Flight Manual (AFM)* and may be affected by location, weather, facilities, etc.

GENERAL

The flight profiles in this chapter show some normal and emergency operating procedures. They are a general guide for training purposes. Actual in-flight procedures may differ due to aircraft configuration, weight, weather, traffic, ATC instructions, etc. Procedures are consistent with the *AFM*. If a conflict develops between these procedures and the *AFM*, then *AFM* procedures must be followed.

PERFORMANCE

The Ultra is certified in accordance with 14 CFR Part 25, which governs certification of transport category aircraft. The Ultra adheres to 14 CFR Part 25 performance requirements, which essentially ensure specific single-engine climb capacity throughout the flight. The following areas help to familiarize the pilot with terms in the *AFM* and to help the pilot understand the capabilities of the aircraft.

TAKEOFF AND LANDING SPEEDS

Refer to the Ultra *AFM* for takeoff and landing speeds.

V_1 (takeoff decision speed)—The distance to continue the takeoff to 35 feet will not exceed the scheduled takeoff field length if recognition occurred at V_1 (accelerate-go). The distance to bring the aircraft to a full stop (accelerate-stop) will not exceed the scheduled takeoff field length provided that the brakes are applied at V_1.

V_R (rotation speed)—The rotation speed is the speed at which rotation is initiated during takeoff to attain the V_2 climb speed at or before a height of 35 feet above runway surface has been reached.

V_2 (takeoff safety speed)—This climb speed is the actual speed at 35 feet above the runway surface as demonstrated in flight during takeoff with one engine inoperative.

V_{ENR} (single engine enroute climb speed)—This speed is the best single-engine rate of climb (altitude vs. time) with flaps zero (V_{YSE}).

V_{REF} (minimum final approach speed)—This is 1.3 times V_{SO} for the flap setting to be used for landing. All charts assume 35° flaps can be used for landing. This is the speed the pilot should have at 50 feet above the runway in order to meet landing distance criteria (refer to the *AFM* for factors affecting landing distance).

V_{APP} (landing (missed) approach climb speed)—This is 1.3 times stall speed with the flaps at 15° and landing gear up.

Speeds are generally posted on the primary flight display (PFD) for quick reference during takeoff or approach.

Minimum maneuvering speeds provide a safety margin above stall speed (for current flap setting and weight) when maneuvering prior to establishing a stabilized final approach. Flying a minimum of 10 kt above 0.6 angle of attack (AOA) for the current flap setting provides this margin. As flaps are extended, the stall speed lowers about 10 kt.

Table 18-1 lists minimum maneuvering speed.

Table 18-1. MINIMUM MANEUVERING SPEEDS

FLAP CONFIGURATION	V_{REF}
CLEAN	+30
FLAPS T.O. (7°)	+20
FLAPS T.O. & APPR	+20
FLAPS FULL	+10

WEIGHTS

Maximum takeoff weight is limited by the most restrictive of:

1. Maximum certified weight (structural)—16,300 pounds
2. Maximum weight permitted by climb requirements
3. Maximum weight permitted by takeoff field length

Takeoff weight may be further limited by obstacle clearance requirements of a departure runway or procedure, or by the landing weight restrictions at destination.

Maximum landing weight is limited by the most restrictive of:

1. Maximum certified landing weight—15,200 pounds
2. Maximum weight permitted by landing field length
3. Maximum landing weight permitted by climb requirements or brake energy limits

Landing weight may be further limited by obstacle clearance requirements of a missed approach procedure.

Some flight departments use pre-printed cards for computations, ATIS and clearances. Sample takeoff and landing (TOLD) cards are shown in Figure 18-1.

FLIGHT OPERATIONS

Sample flight profiles are shown in Figures 18-2 through 18-17.

PREFLIGHT AND TAXI

If flying as a crew, the pilot-in-command ensures that the second-in-command understands the normal and emergency procedures to be used for that takeoff. This includes verbal callouts during takeoff roll and initial climb (Table 18-2).

FlightSafety international — CITATION

TAKE OFF DATA

T/O N_1	**CLB N_1**	
V_1	**V_R**	**V_2**
V_{FR}	**V_{ENR}**	FLAPS

CLEARANCE

ARPT____________ ELEV ______ RWY ______

ATIS______ WIND _____ VIS_______________

CIG _______________ TEMP/DP_____ / ____

ALT ___________RMKS ___________________

RWY LENGTH__________ RWY REQ'D ________

ZFW______________ T.O. WT.______________

EMERGENCY RETURN

V_{REF}___________ V_{APP} _______ MSA _________

FlightSafety international — CITATION

LANDING DATA

V_{REF}	**V_{APP}**
GA N_1	RWY REQ'D

CLEARANCE

ARPT____________ ELEV ______ RWY ______

ATIS______ WIND _____ VIS_______________

CIG _______________ TEMP/DP_____ / ____

ALT ___________RMKS ___________________

ZFW______________ T.O. WT.______________

Figure 18-1. Takeoff and Landing Data (TOLD) Card

Table 18-2. EXAMPLE CALLOUTS (IFR AND VFR)

PHASE	CONDITION	CALLOUT
Takeoff	Both airspeed indicators moving	“Airspeed alive”
	Both airspeed indicators indicating 70 KIAS	“70 knots”
	Airspeed indicators at computed V_1	“V_1”
	Airspeed indicators at computed V_R	“Rotate”
	Airspeed indicators at computed V_2	“V_2”
Departure/ Enroute/ Approach	Prior to intercepting an assigned course	“Course alive”
Climb and descent	Approaching transition altitude (IFR and VFR)	“Transition altitude altimeters reset”
	1,000 feet above/below assigned altitude (IFR)	State altitude leaving and assigned level-off altitude
Final	At final approach fix	(Fix) altimeters and instruments check (NOTE 1)
	500 feet above minimums	“500 above minimums”
	100 feet above minimums	“100 above minimums”
	Runway acquisition	“Runway at (clock position)” or “Approach lights at (clock position)” (NOTE 2)
	After pilot flying reports “visual,” pilot not flying reverts to instruments and callouts	“V_{REF}” “Sink (rate of descent)” “On,” “Above,” or “Below glide slope,” if required
	At decision height (DH)	“Minimums, runway not in sight” or “Minimums, runway at (clock position)” or “Minimums, approach lights, at (clock position)” (NOTE 2)
	At minimum descent altitude (MDA)	“Minimums” (NOTE 2)
	At missed-approach point (MAP)	“Missed-approach point, runway not in sight” or “Missed-approach point, runway at (clock position)” or “missed-approach point, approach lights, at (clock position)”

NOTES:

1. CHECK FOR APPEARANCE OF WARNING FLAGS AND GROSS INSTRUMENT DISCREPANCIES.
2. CARE MUST BE EXERCISED TO PRECLUDE CALLOUTS, WHICH CAN INFLUENCE THE PILOT FLYING AND RESULT IN PREMATURE ABANDONMENT OF INSTRUMENT PROCEDURES.

Sample Takeoff Briefing

"This will be a static (or rolling) takeoff with flaps at 15° (or 7°). Check takeoff power and call "speed alive, 70 knots, V_1 and rotate." I will call for gear up, flaps, and yaw damp. The departure is _____. Call abort for any malfunction below 70 knots. I will control the aircraft and you extend speedbrakes and call tower. Between 70 and V_1 we will only abort for red lights, loss of directional control or loss of major displays. After V_1 we will handle all problems in flight. We will climb to _____ feet before doing any actions. I will fly and talk to ATC, and you can run the checklist. If I do not respond to you or I do something dangerous or stupid, assume controls and we will sort it out later. Any questions or comments?"

TAKEOFF

Normal

It is recommended to use the flight director during takeoff. Press the TO/GA button on the left or right throttle, then select the HDG mode. After lining up on the centerline, press down on the heading knob. Advance power and call "power set." The copilot should set the final adjustment to takeoff power. At V_1 move your hand from the throttles to the yoke and rotate at V_R toward the command bars. With a definite climb, raise the gear; raise flaps no earlier than V_2 + 10 kt. Continue climb in the pitch mode until nearing 170 kt, then select FLC mode (if desired) and reduce throttles as needed (Figure 18-2).

Rejected (Before V_1)

Simultaneously apply brakes, reduce throttles to idle and apply rudder pedal pressure for nosewheel steering. Extend the speedbrakes and deploy the thrust reversers as needed. Notify the tower and accomplish any other memory items as needed.

Engine Failure (After V_1)

Control direction, rotate at V_R and raise the gear with a positive climb. Use the rudder for directional control; a small amount of aileron may be needed to keep the wings level. Climb at V_2 until reaching an altitude you determine to be clear of obstacles (no lower than 1,500 feet above the airport). Use minimum safe, minimum enroute, or ATC assigned altitudes. Rudder trim and yaw damper may be used. After level off accelerate toward 160 kt and raise the flaps no earlier than V_2 + 10 kt. If further climbs are needed, use V_{ENR}. Retrim rudder and aileron as needed as speed increases (Figure 18-3).

Normal Climb

Ensure gear and flaps are up, set power as needed and select autopilot (if desired). Monitor pressurization and fuel. Climb at approximately 250 kts until .62 Mach indicated, or as desired, to cruise altitude. Complete appropriate checks (refer to the *AFM*).

Cruise

Adjust throttles as needed to prevent aircraft overspeed. Reset pressurization for destination. Complete appropriate checks.

Descent

Monitor the windshield for icing when descending into humid conditions. Begin arrival/approach tasks. Complete appropriate checks.

Approach and Landing

Ensure proper navigation aids are set for planned approach. Load the planned approach into the flight management system (FMS) and utilize its capabilities as desired. Discuss crew actions for the approach and any potential missed approach.

Sample Approach Briefing

> "We are flying the _____ approach to runway ____. Nav 1 and 2 are set to ____; minimums are set at ____ both sides. V speeds are set at _____. We will use the _____ modes to a DA (or MDA) of _____. Landing flaps and gear by the FAF. Call 1,000, 500 and 200 feet above minimums. Tell me where the runway is; I will call landing or go-around. In the event of a missed, change NAV source to FMS after gear up. The missed approach is _____ to ____ and hold. If I do not respond to you or I do something dangerous or stupid, assume controls and we will sort it out later. Any questions or comments?"

When nearing approach altitudes, use about 55–60% fan if near 200 kt. As you configure the aircraft, speed decreases. Plan to reach the glideslope (GS) intercept or final approach fix (FAF) with the landing gear down, flaps set, and speed set. If flying a straight-in two-engine approach, plan to have flaps set at 35° by the FAF; this permits a stabilized approach throughout final. If flying a one-engine approach, use flaps 15° on final. Decide early if the landing can be with flaps 15° or 35°; ensure sufficient runway is available for reduced flaps. Landing with flaps 15° allows for a stabilized approach throughout final. If circling to land, plan to fly the approach with flaps 15° until you decide landing is assured; then select 35°.

Plan to arrive over the threshold at V_{REF} for the flap setting desired at 50 feet above the runway with the yaw damper off. Idle power can then be selected. Following a normal flare, lower the nose and then deploy thrust reversers and apply toe brakes simultaneously. When clear of the runway, accomplish the after landing checks.

After Landing

If flying as a crew, the checks may be performed while taxiing. If flying single pilot, complete all checks before taxiing.

AIRWORK MANEUVERS

STEEP TURNS

Steep turns are flown at 45° of bank and 200 knots (Figure 18-13). FAA directives prohibit a second pilot from aiding the flying pilot in any manner except in the performance of normal copilot duties (no verbal or physical help). Establish a base heading and altitude. Maintain the altitude during the maneuver and use the base heading for the turn reversal and final roll out. Use of the flight director, elevator trim, and yaw damper is an option for the pilot.

A pitch attitude of about 2.5° should hold level flight in the turns. A small power increase is needed to maintain 200 kt. If a moderate roll in rate is used to begin the maneuver, plan to use a 10° heading lead point for reversing the turn and for the final roll out.

APPROACH TO STALLS

Full stalls are not permitted. Initiate recovery at the first indication of an impending stall. Maintain altitude during the approach to stall. If wings level, maintain heading. If in a turn, use 15–30° bank. Trim as needed until nearing 0.6 AOA or V_{REF} for current flaps. When initiating recovery, use takeoff power and level the wings. Return to the starting altitude as soon as performance allows. The goal is minimum altitude loss.

Clean

Set power at approximately 40% N_1; use speedbrakes to assist speed reduction. The "gear warning horn" sounds passing through 150 KIAS (silence horn if desired). At stick shaker or buffet, apply maximum power, maintain pitch, and level the wings. As speed increases, return to the starting altitude and retrim; reduce power (Figure 18-10).

Flaps 15°

Roll into a 20° bank, set power at approximately 45% N_1 and set flaps to 15°. The "gear warning horn" sounds passing through 150 KIAS (silence horn if desired). At stick shaker or buffet, maintain pitch attitude and add takeoff power. As speed increases, raise the flaps at V_{APP} + 10, return to starting altitude, and retrim; reduce power (Figure 18-11).

Landing

Set power at approximately 45% N_1, and configure the aircraft. At stick shaker or buffet, maintain pitch attitude and add takeoff power; then select flaps 15°. As speed increases, increase pitch to stop descent; at a positive rate, raise the gear. Raise the flaps as the aircraft accelerates past V_{APP} + 10; return to starting altitude and retrim; reduce power (Figure 18-12).

UNUSUAL ATTITUDE RECOVERIES

Unusual attitudes do not have to be severe to be unusual; they are simply not what you expected. Recognize the attitude by looking at all three attitude indicators. Confirm by reference to airspeed, altitude, and heading changes. Use the best instrument available to control the recovery. Return to wings-level, level flight before chasing command bars. Do not put yourself into a second unusual attitude with rapid control inputs.

Nose High

If needed, add power to preserve airspeed. Do not push the nose down. Relax any back pressure you may be applying. Consider using some bank to help lower the nose.

Nose Low

If needed, reduce power and/or use speedbrakes to control airspeed. Roll to an upright attitude and add back pressure to stop descent.

MISCELLANEOUS

Takeoff and Landing

For takeoff, lineup as close to the end of the runway as possible and perform a static runup to takeoff power. Ensure strict adherence to V_1 and V_R speeds.

For landing, ensure airspeed is at V_{REF} at 50 feet over the threshold. Do not float the flare. As soon as the main tires are on the ground, lower the nose and extend speedbrakes (aircraft with nose gear actuator modified by service bulletin). When the nose wheel is firmly on the ground, extend speedbrakes and thrust reversers (aircraft with nose gear actuator not modified by service bulletin).

Touch-and-Go Landings

If doing touch-and-go landings, select HIGH position with the ground idle switch. Consider using only 15° flaps on those landings; no need to change flaps on roll. If using 35° flaps for the landings, hold the nose wheel on the runway while the other pilot sets the flaps to 15°. If power is added before the flaps are reset, airspeed can be higher than normal at liftoff.

Adverse Runway Conditions

Ensure the proper performance charts are used when taking off or landing on runways with adverse conditions. If the chart does not cover your particular situation, strongly consider not taking off or landing. Hydroplaning occurs at 9.0 times the square root of the tire pressure for a water-covered runway. Approximate speeds equate to 85–90 kt.

If landing or taxiing on slush, inspect drains, control surfaces, and wheels after shutdown.

Cold Weather

Comply with the cold weather operations outlined in the *AFM*, Section 3.

Servicing

Comply with fluid requirements outlined in the *AFM*, Section 2.

Type/ATP/61.58 PIC Checkride

A type or ATP practical test has a ground portion and a flight portion. The ground portion is a knowledge examination of aircraft systems, limitations, and normal, abnormal and emergency procedures. Also included is a weight and balance problem with a weight shift. The type, ATP, or 61.58 PIC flight portion includes an aircraft exterior inspection and the following operations:

1. Interior preflight, ground operations, engine start, and taxi
2. Takeoffs (normal, crosswind, instrument, rejected, and with an engine failed)
3. Departure, arrival, and holding
4. Airwork (steep turns, approaches to stalls, unusual attitude recoveries)
5. Two ILS approaches (a normal, two-engine approach and a hand-flown single-engine approach)
6. Two different nonprecision approaches (one hand flown; one a GPS; and one that concludes with a circle to land)
7. Two missed approaches (one from an ILS; one published; and one single-engine)
8. Landings (normal, crosswind, rejected, from an ILS, circling, and with an engine failed)
9. Normal, abnormal, and emergency procedures
10. Special emphasis areas such as CRM, runway incursion, traffic avoidance, etc.

FAA PTS Tolerances (Abbreviated)

1. Takeoffs and missed approaches: heading ±5°; speed ±5 kt; altitude ±100 feet
2. Steep turns: heading ±10°; speed ±10 kt; altitude ±100 feet; bank ±5°
3. Stalls—Announces first indication of impending stall; applies smooth, positive control during entry and recovery
4. Unusual attitude recovery—Uses proper controls to return to normal flight
5. ILS—Stabilized approach from GS intercept to decision altitude (DA) with no more than one dot deviation in localizer or glideslope during instrument and visual portion; speed ±5 kt
6. Nonprecision approach, MDA + 50 to –0 feet; CDI within one dot of center; bearing pointer within ±5°; speed ±5 kt
7. Circling—MDA +100 to –0 feet until ready to land; bank 30° maximum; speed ±5 kt; maneuvers by visual reference without exceeding visibility criteria
8. Landing—500 to 3,000 feet past threshold on centerline; sufficient runway for abnormal condition

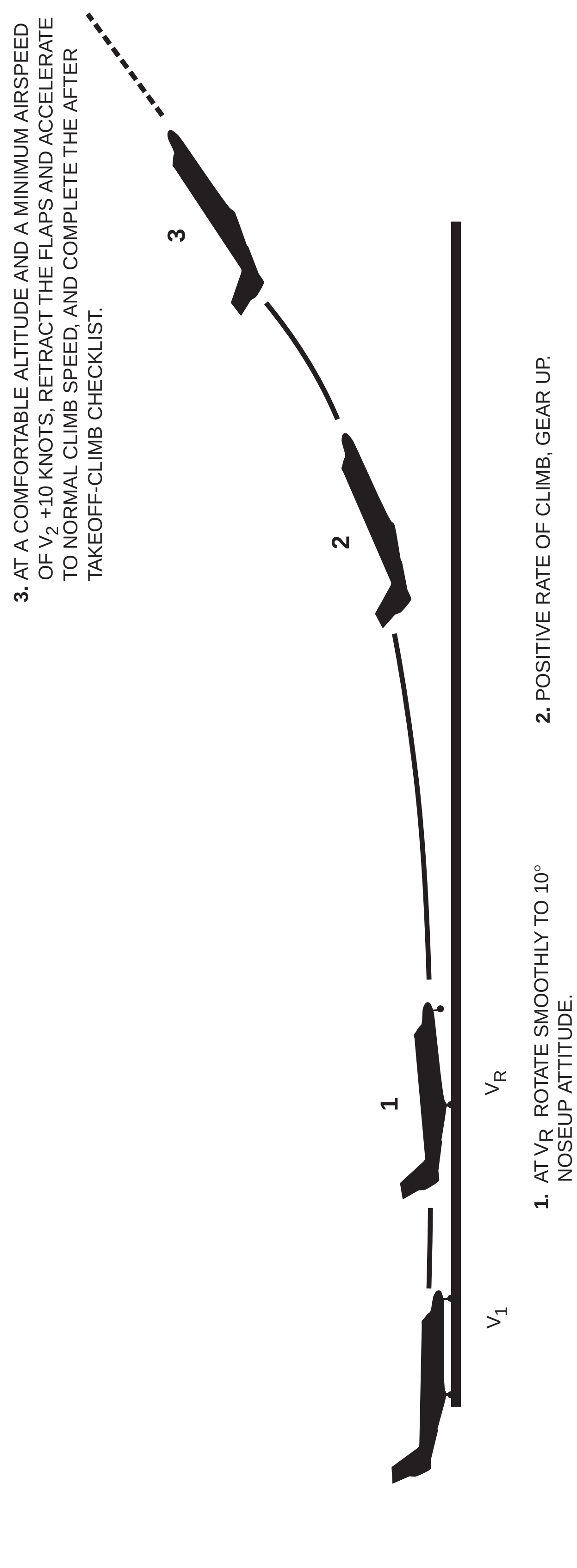


Figure 18-2. Takeoff—Normal

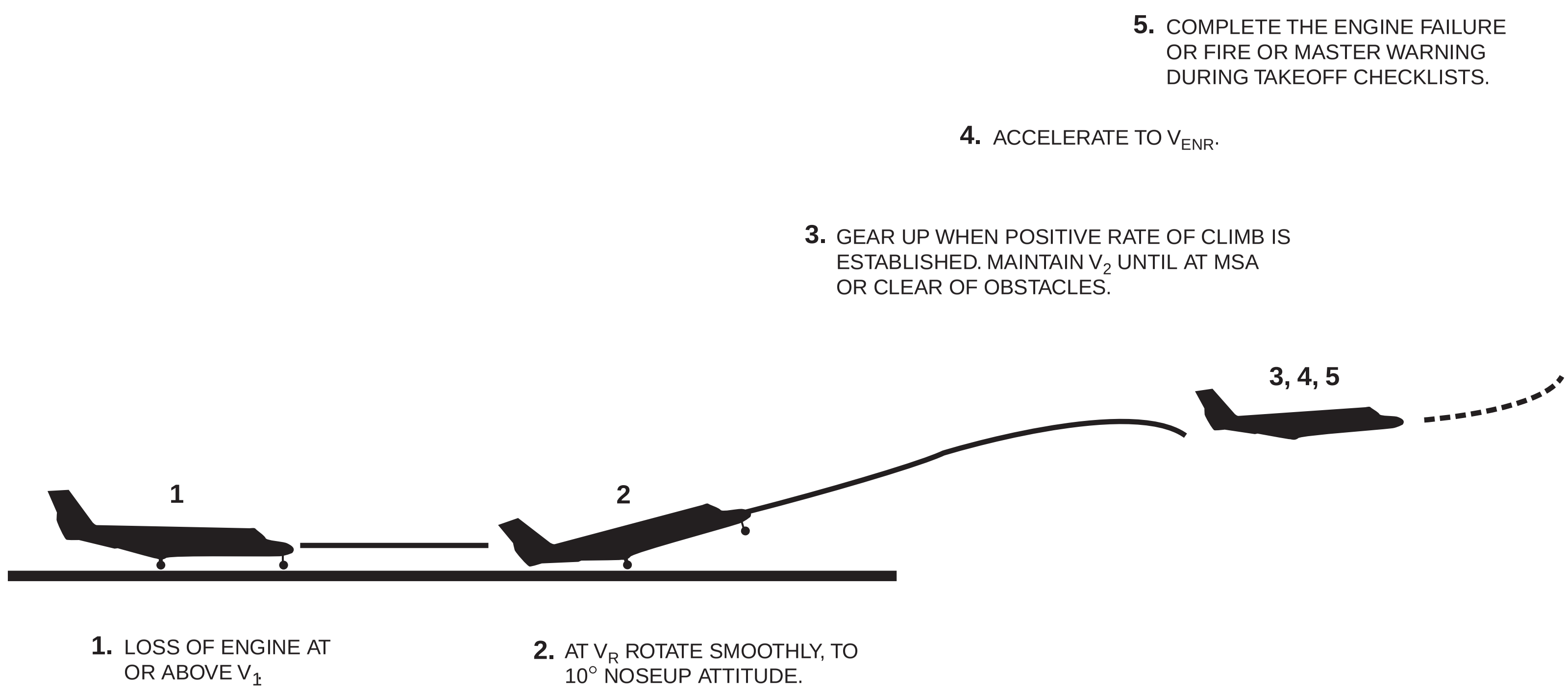
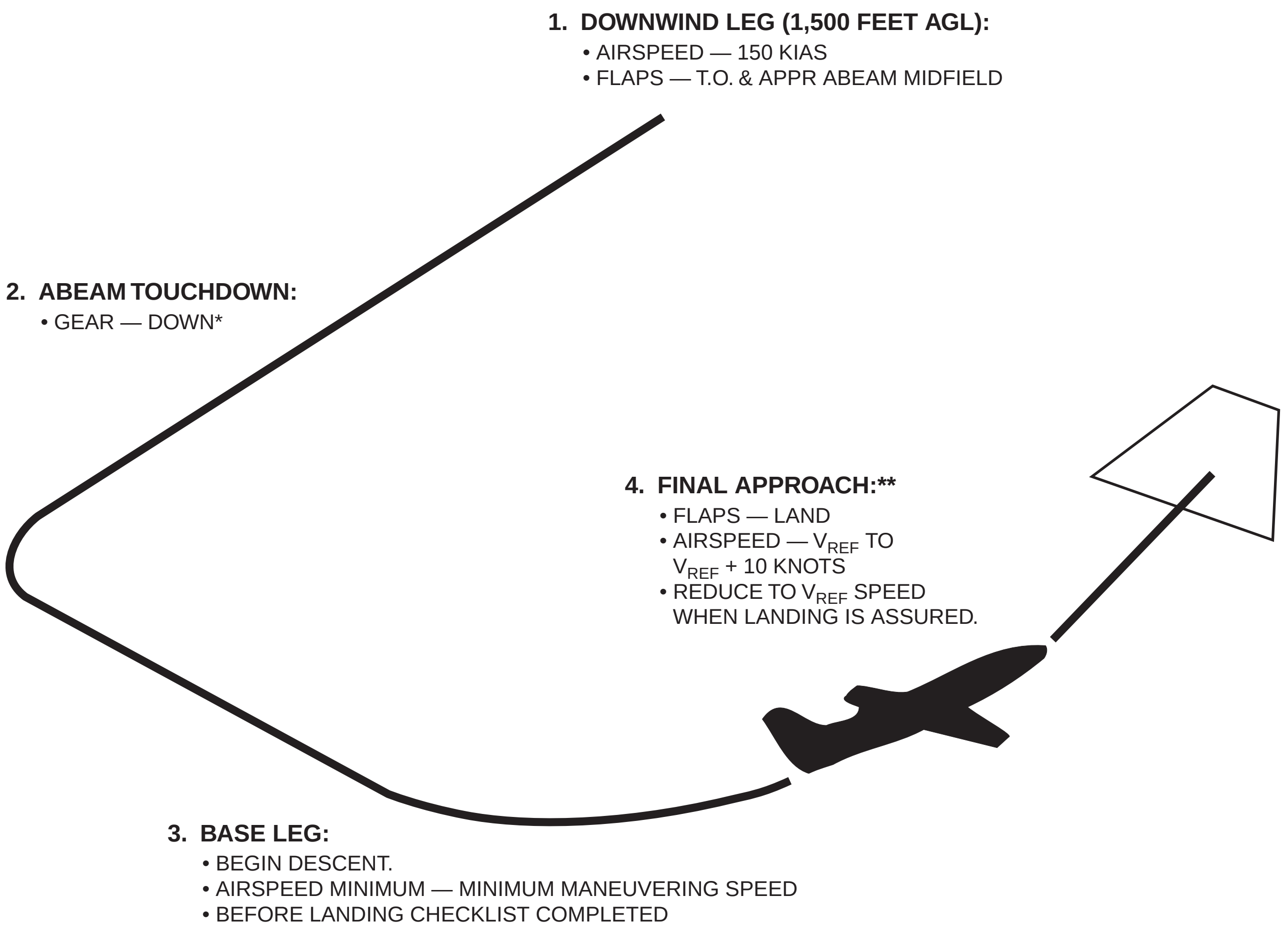


Figure 18-3. Takeoff—Engine Failure At or Above V_1

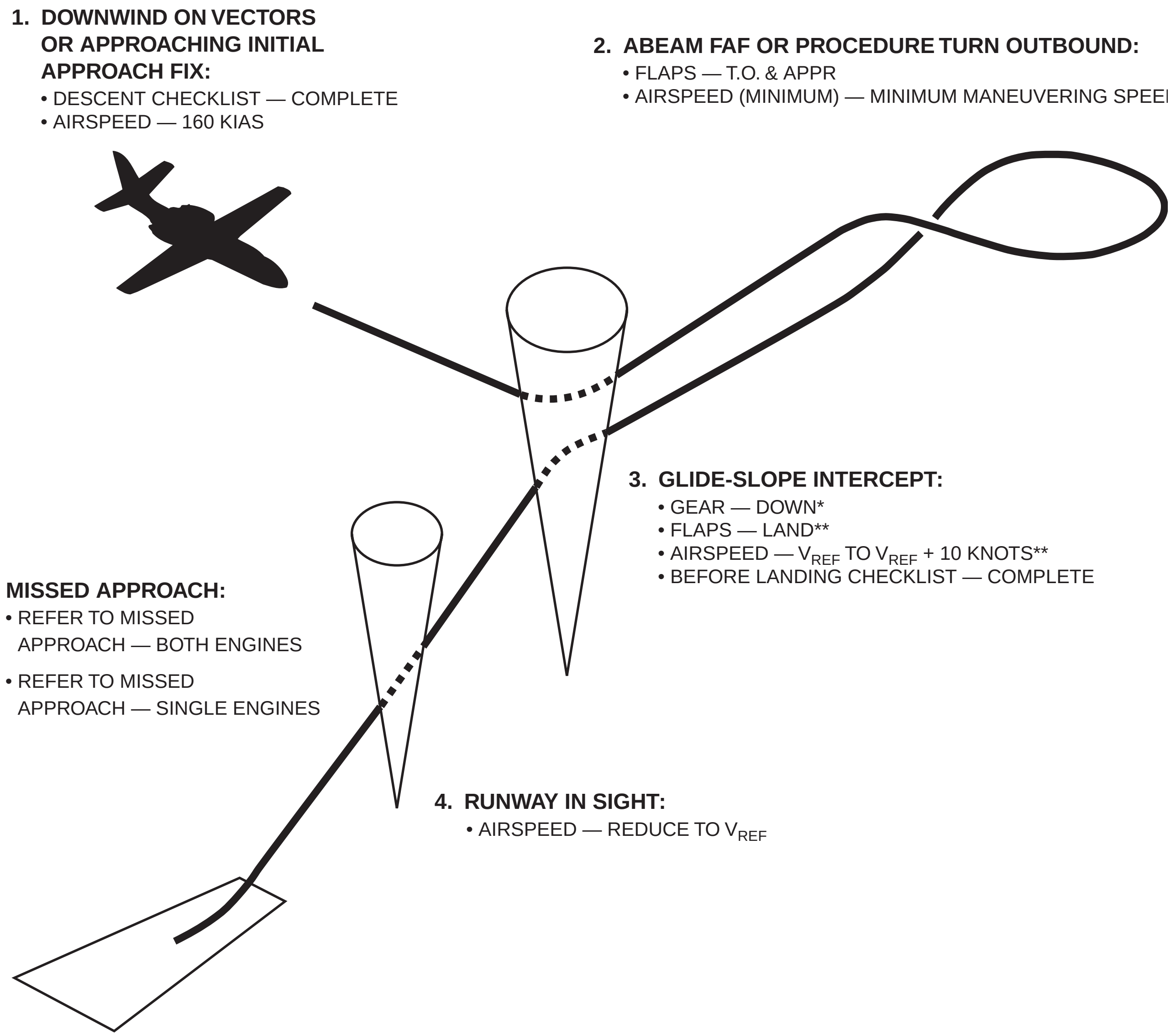


NOTE:
IN GUSTY WIND CONDITIONS, INCREASE V_{REF} BY 1/2 OF THE GUST FACTOR IN EXCESS OF 5 KNOTS.

* IF BEING RADAR-VECTORED TO A VISUAL APPROACH, LOWER THE GEAR ON BASE LEG OR NO LATER THAN THREE MILES FROM THE THRESHOLD ON A STRAIGHT-IN APPROACH.

** SINGLE ENGINE — V_{APP} MINIMUM AND MAINTAIN FLAPS APPROACH UNTIL LANDING IS ASSURED.

Figure 18-4. VFR Approach—Normal/Single Engine

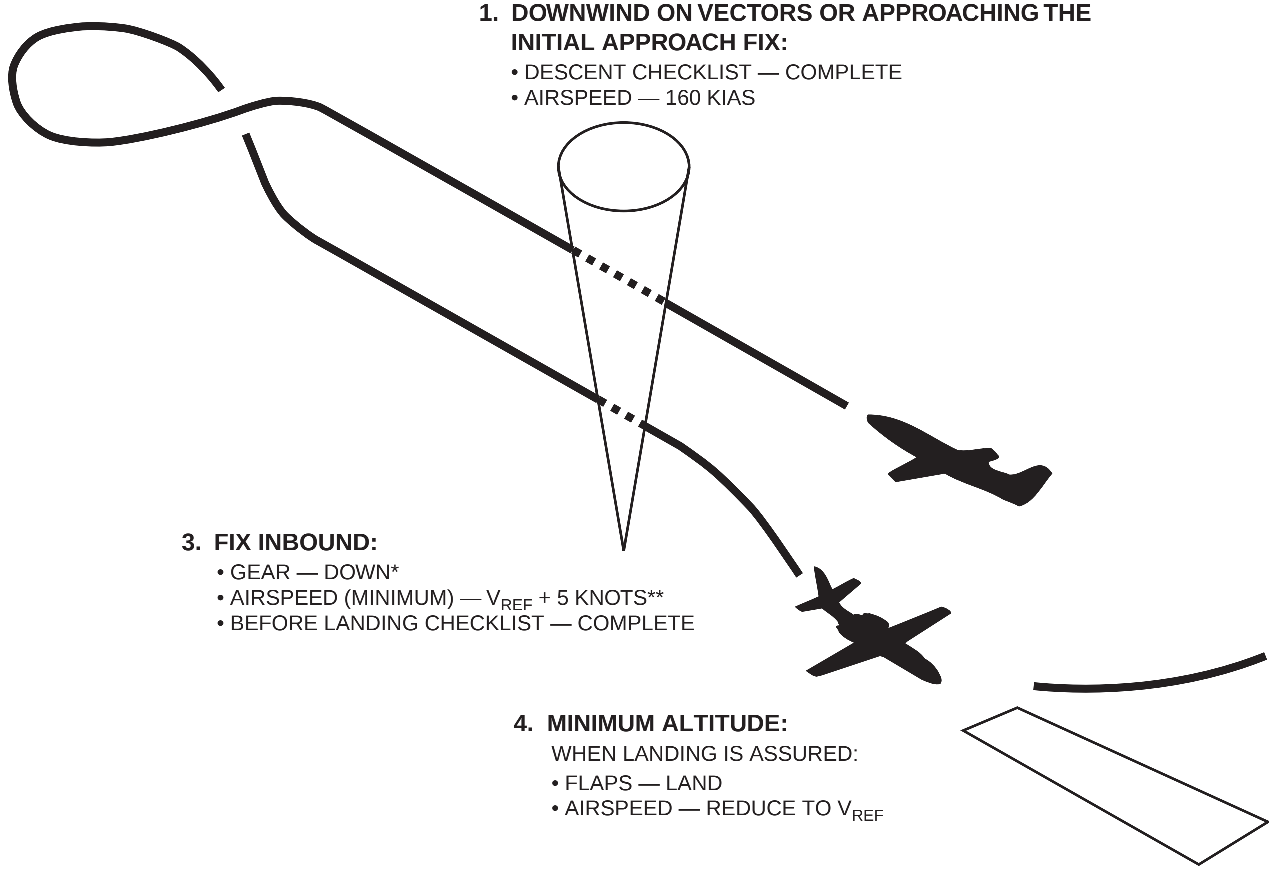


NOTE:
IN GUSTY WIND CONDITIONS INCREASE V_{REF} BY 1/2 OF THE GUST FACTOR IN EXCESS OF 5 KNOTS.

* ONE DOT PRIOR TO GLIDE-SLOPE INTERCEPT WITH TWO ENGINES; AT GLIDE-SLOPE INTERCEPT WITH ONE ENGINE.

** SINGLE ENGINE — V_{APP} (MINIMUM) WITH FLAPS AT APPROACH UNTIL LANDING IS ASSURED, THEN FLAPS TO LAND AND AIRSPEED V_{APP} CROSSING THRESHOLD.

Figure 18-5. ILS Approach—Normal/Single Engine



NOTE:
IN GUSTY WIND CONDITIONS, INCREASE V_{REF} BY 1/2 OF THE GUST FACTOR IN EXCESS OF 5 KNOTS.

FOR CIRCLING APPROACHES, MAINTAIN MINIMUM MANEUVERING SPEED CONSISTENT WITH FLAP POSITION. TURN FINAL, SELECT FLAPS TO LAND, AND REDUCE TO V_{REF} SPEED WHEN LANDING IS ASSURED.

* ENSURE GEAR IS DOWN AND LOCKED BY FAF.
** SINGLE ENGINE — V_{APP} (MINIMUM) WITH FLAPS AT APROACH UNTIL LANDING IS ASSURED, THEN FLAPS TO LAND AND AIRSPEED V_{REF} CROSSING THRESHOLD.

Figure 18-6. Nonprecision Approach—Normal/Single Engine

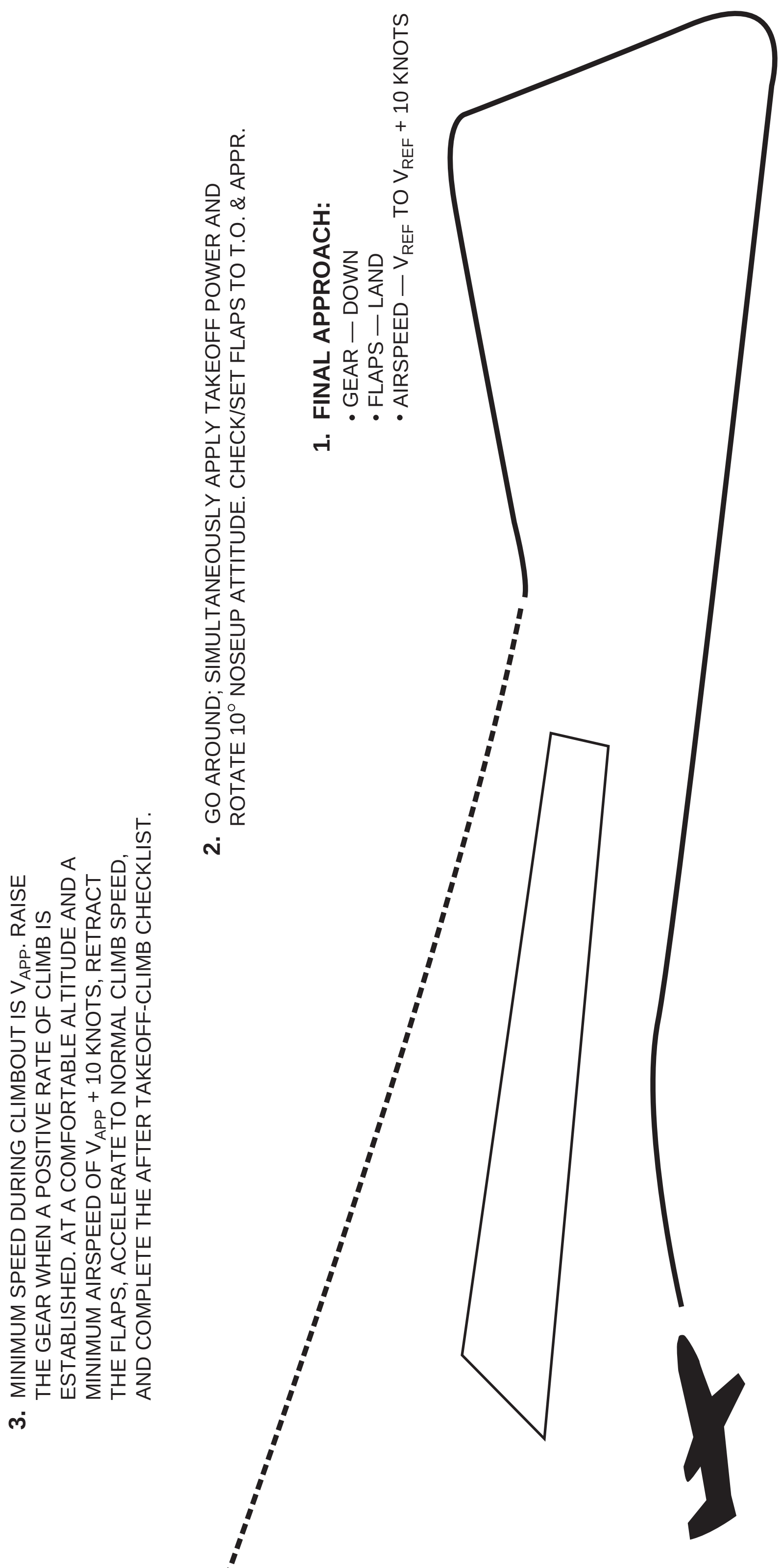


Figure 18-7. Missed Approach—Two Engine

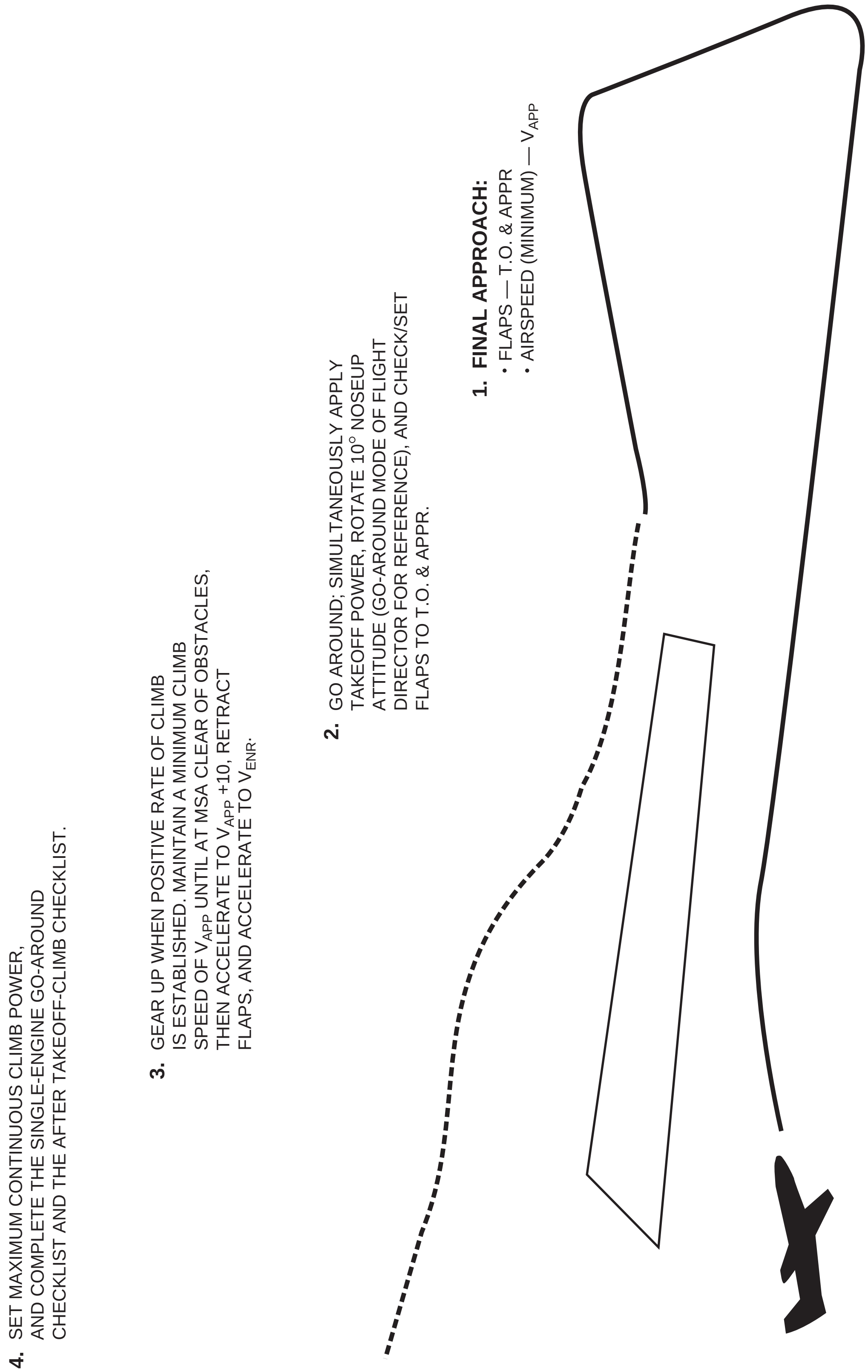


Figure 18-8. Missed Approach—Single Engine

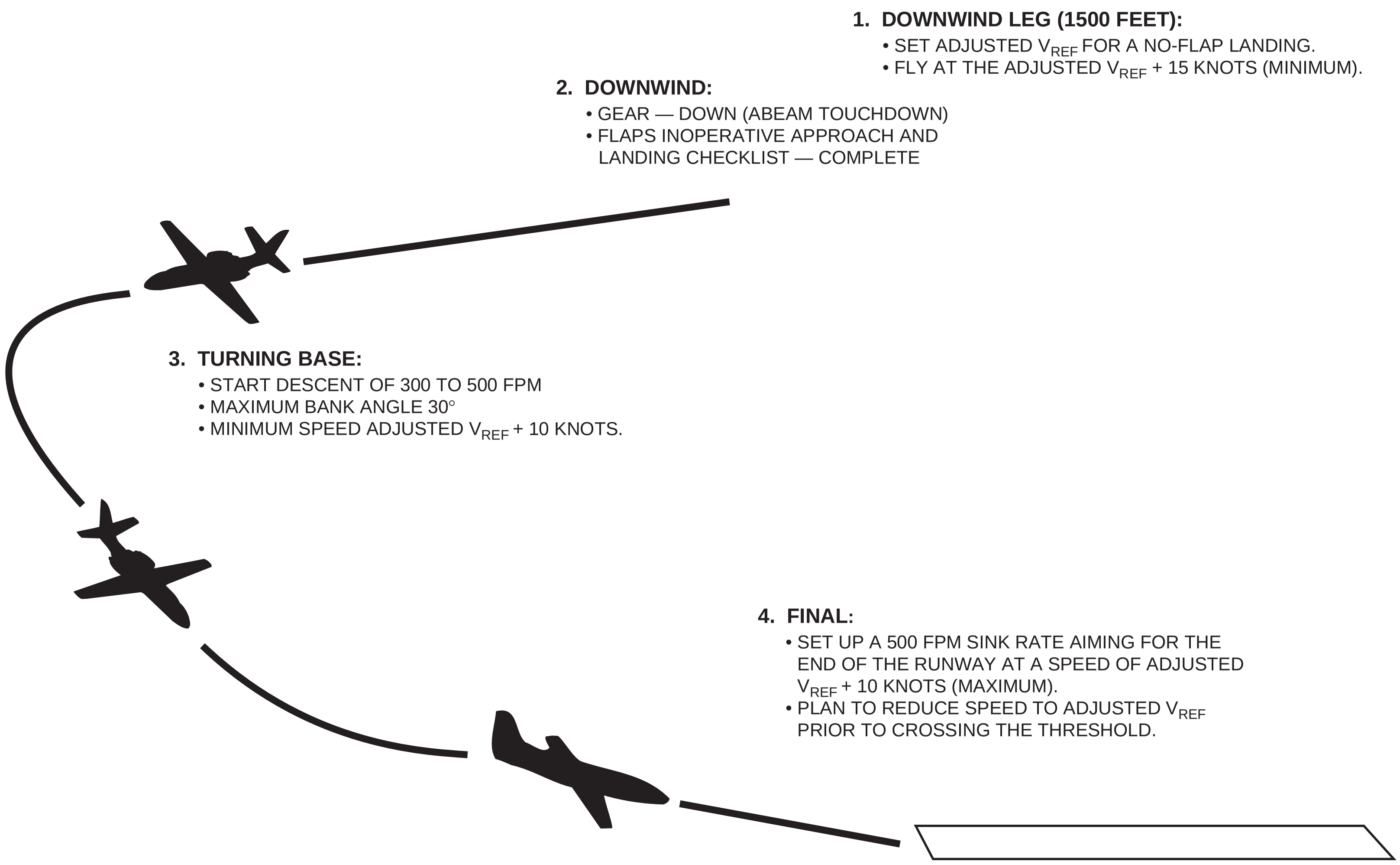


Figure 18-9. Visual Approach—With No Flaps

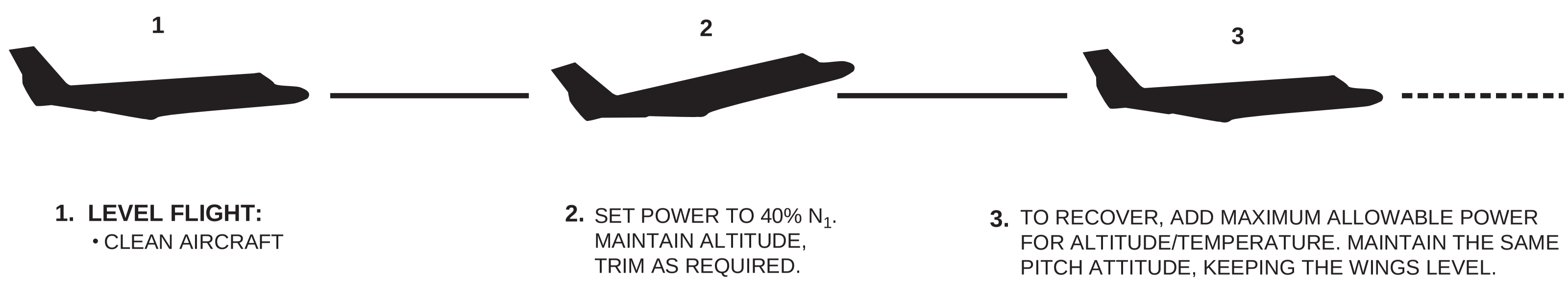
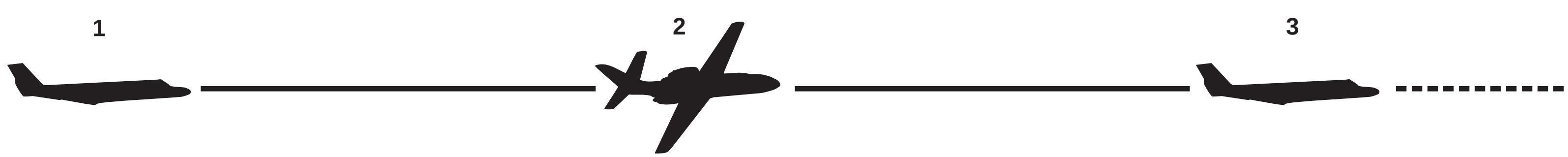


Figure 18-10. Approach to Stall—Clean Configuration



1. LEVEL FLIGHT:
- FLAPS — T.O. & APPR

2. ROLL INTO A 20° BANK. SET POWER TO 45% N_1. MAINTAIN ALTITUDE, TRIM AS REQUIRED.

3. TO RECOVER, ADD MAXIMUM ALLOWABLE POWER FOR ALTITUDE AND TEMPERATURE. CHECK THAT THE FLAPS ARE AT THE T.O. & APPR POSITION. MAINTAIN THE SAME PITCH ATTITUDE, AND ROLL THE WINGS LEVEL. ALLOW THE SPEED TO INCREASE TO V_{APP} + 10 KNOTS AND RETRACT THE FLAPS.

NOTE:
USE THE RUDDER TO AID IN LEVELING THE WINGS. THIS WILL MINIMIZE THE ADVERSE YAW PRODUCED BY DOWN AILERON.

Figure 18-11. Approach to Stall—Flaps 15° Configuration

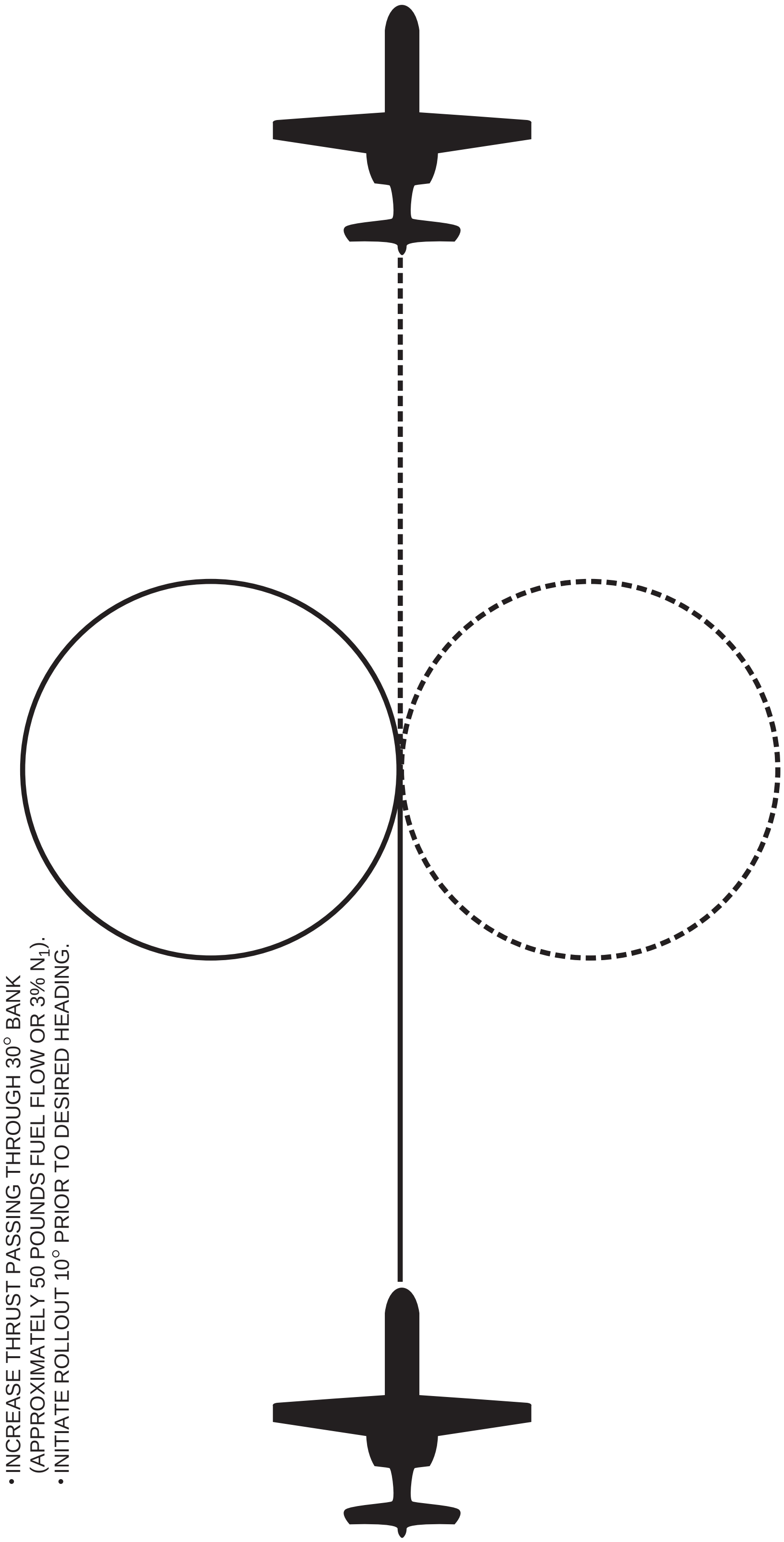
1. **LEVEL FLIGHT:**
   - GEAR — DOWN
   - FLAPS — LAND

2. SET POWER TO 45% N_1. MAINTAIN LEVEL FLIGHT UNTIL THE STALL INDICATION OCCURS. TRIM AS REQUIRED.

3. TO RECOVER, SIMULTANEOUSLY ADD MAXIMUM ALLOWABLE POWER, LOWER PITCH ATTITUDE TO THE HORIZON, KEEPING WINGS LEVEL, AND CALL FOR FLAPS TO TAKEOFF AND APPROACH.

4. AS AIRSPEED REACHES V_{APP}, ROTATE SLOWLY AND SMOOTHLY TO 10° NOSEUP, AND HOLD THIS SPEED UNTIL A POSITIVE RATE OF CLIMB IS ATTAINED. RETRACT THE GEAR. CLIMB TO YOUR MDA AT V_{APP} THEN ALLOW THE AIRSPEED TO INCREASE TO V_{APP} + 10 KNOTS, AND RETRACT THE FLAPS.

Figure 18-12. Approach to Stall—Landing Configuration



PROCEDURE
- AIRSPEED — 200 KIAS
- BANK ANGLE — 45°
- MAINTAIN ALTITUDE.
- INCREASE THRUST PASSING THROUGH 30° BANK (APPROXIMATELY 50 POUNDS FUEL FLOW OR 3% N_1).
- INITIATE ROLLOUT 10° PRIOR TO DESIRED HEADING.

Figure 18-13. Steep Turns

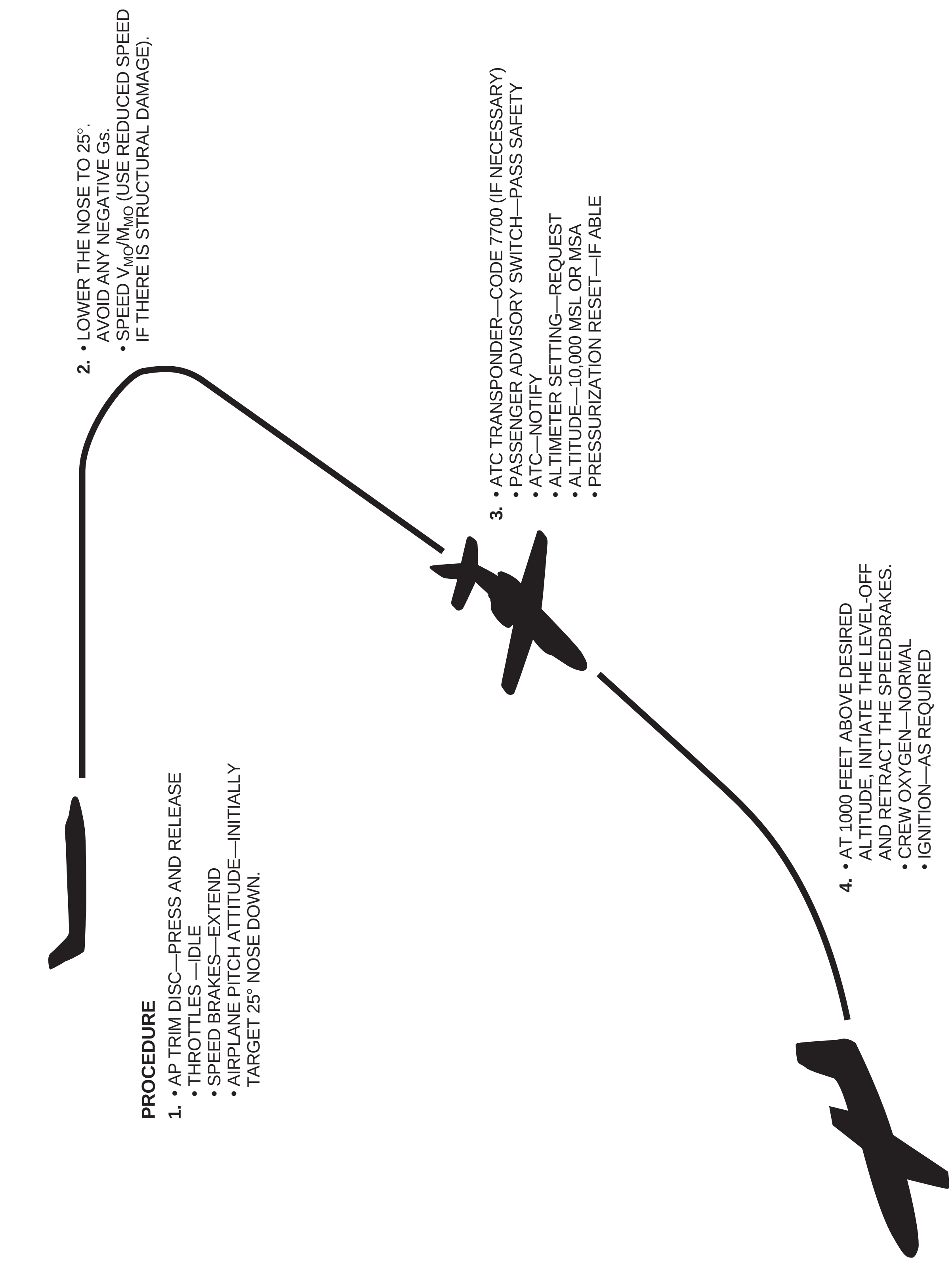


Figure 18-14. Emergency Descent

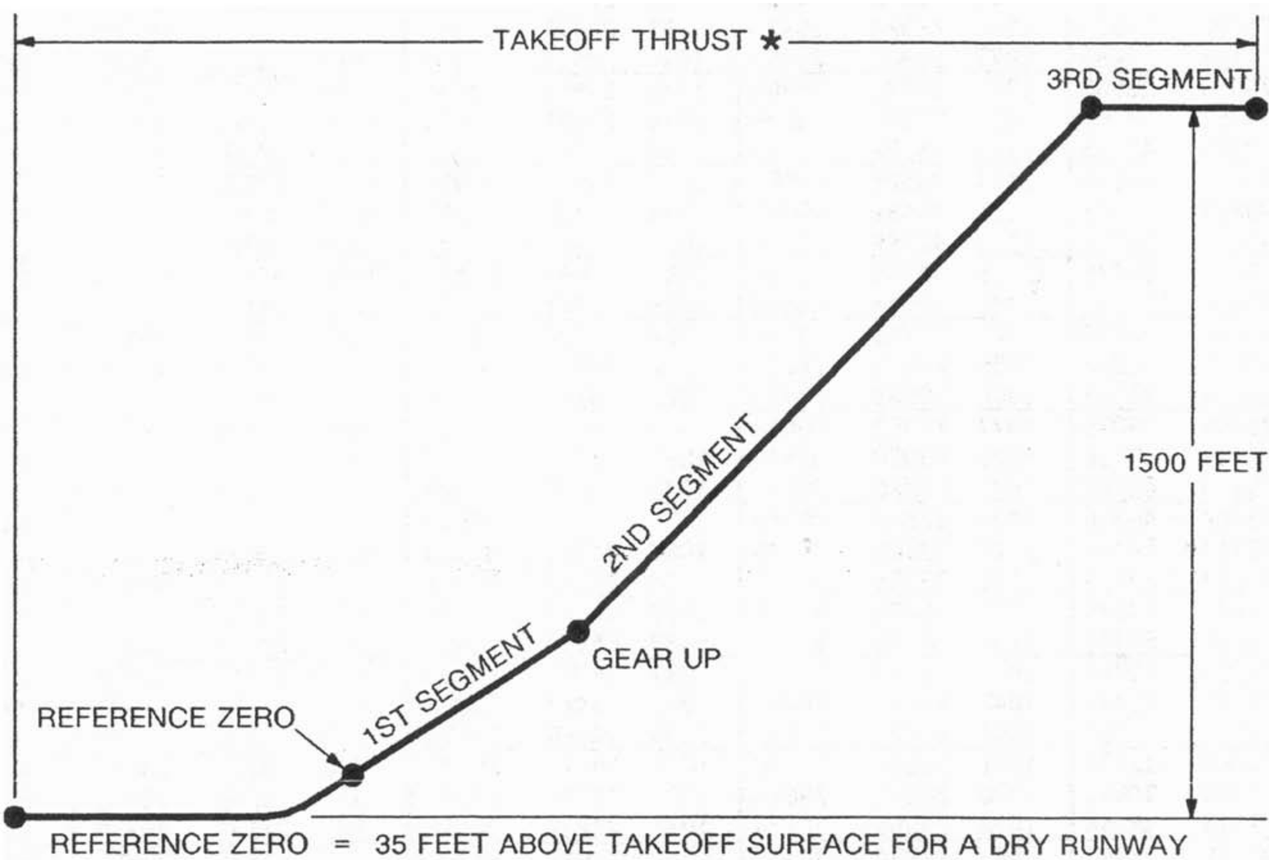


Figure 18-15. FAR Part 25 Climb Profile

CHAPTER 19
WEIGHT AND BALANCE

CONTENTS

ILLUSTRATIONS

CHAPTER 19
WEIGHT AND BALANCE

INTRODUCTION

This chapter provides procedures for determining the weight and balance for flight. Information is provided for items on the Weight and Balance Data Sheet, which is provided with the aircraft as delivered from Cessna Aircraft Company.

WARNING

It is the responsibility of the pilot to make sure the aircraft is loaded properly. The aircraft must be loaded so as to remain within the weight and balance limits prescribed in the *Airplane Flight Manual (AFM)* for takeoff and landing.

GENERAL

WEIGHT

Aircraft maximum weights are predicated on structural strength. It is necessary to ensure that the aircraft is loaded within the various weight restrictions to maintain structural integrity.

BALANCE

Balance, or the location of the center of gravity (CG), deals with aircraft stability. The horizontal stabilizer must be capable of providing an equalizing moment to that which is produced by the remainder of the aircraft. Since the amount of lift produced by the horizontal stabilizer is limited, the range of movement of the CG is restricted so that proper aircraft stability and control is maintained. Adding fuel, passengers, or baggage (in the nose compartment) shifts the center-of-gravity forward since all of them are loaded forward of the typical standard empty weight center-of-gravity.

Stability increases as the CG moves forward. If the CG is located out of limits too far forward, the aircraft may become so stable that it cannot be rotated at the proper speed or flared for landing.

The aft of limits CG situation is considerably worse because the stability decreases. Here, the horizontal stabilizer may not have enough nosedown elevator travel to counteract a noseup pitching movement, resulting in a possible loss of control.

BASIC FORMULA

Weight x Arm = Moment

This is the basic formula upon which all weight and balance calculations are based. Remember that the arm or CG location can be found by adapting the formula as follows:

$$\text{Arm} = \frac{\text{Moment}}{\text{Weight}}$$

WEIGHT SHIFT FORMULA

$$\frac{\text{Weight shifted}}{\text{Total weight}} = \frac{\text{Distance CG is shifted}}{\text{Distance weight is shifted}}$$

The above formula can be utilized to shift weight if the CG is found to be out of limits. Use of this formula avoids working the entire problem over again by trial and error.

WEIGHT ADDITION OR REMOVAL

If weight is to be added or removed after a weight and balance has been computed, a simple formula can be used to figure the shift in the center of gravity.

$$\frac{\text{Weight added (or removed)}}{\text{New total weight}} = \frac{\text{Distance the CG is shifted}}{\text{Distance between the weight arm and the old CG arm}}$$

If it is desired to find the weight change needed to accomplish a particular CG change, the formula can be adapted as follows:

$$\frac{\text{Weight to be added (or removed)}}{\text{Old total weight}} = \frac{\text{Distance the CG is shifted}}{\text{Distance between the weight arm and the new CG arm}}$$

DEFINITIONS

Actual Zero Fuel Weight—Basic empty weight plus payload. It must not exceed maximum zero fuel weight.

Basic Empty Weight—Standard empty weight plus installed optional equipment. This is the weight reflected on the weight and balance data Form 2255 supplied with the aircraft.

Basic Operating Weight—Basic empty weight plus crew and furnishings without passengers, baggage, or cargo.

Landing Weight: Zero fuel weight plus fuel load at landing.

MAC—Mean Aerodynamic Chord. The chord of an imaginary airfoil, which throughout the flight range has the same force vectors as those of the wing.

Maximum Landing Weight—Maximum weight for landing as limited by aircraft strength and airworthiness requirements.

Maximum Takeoff Weight—Maximum weight for takeoff as limited by aircraft strength and airworthiness requirements. This is the maximum weight at start of takeoff run.

Maximum Ramp Weight—Maximum weight for ground maneuvers as limited by aircraft strength and airworthiness requirements. It includes weight of taxi and runup fuel.

Maximum Zero Fuel Weight—Maximum weight allowed exclusive of usable fuel.

Operational Takeoff Weight—Weight at the start of the takeoff run. It must not exceed maximum takeoff weight, and it is also subject to airport, operational, and related restrictions.

Operational Landing Weight—Weight at the start of the landing touchdown. It must not exceed maximum landing weight, and it is also subject to airport, operational, and related restrictions.

Payload—Maximum zero fuel weight minus basic empty weight. This is the weight available for crew, passengers, baggage, and cargo.

Ramp Weight: Zero fuel weight plus total fuel load.

Standard Empty Weight—Weight of standard aircraft including standard items.

Standard Items—Equipment and fluids not an integral part of a particular aircraft and not a variation for the same type of aircraft. These items may include, but are not limited to, the following:

- Unusable fuel
- Engine oil
- Toilet fluid
- Serviced fire extinguisher
- All hydraulic fluid
- Trapped fuel

Takeoff Weight: Zero fuel weight plus fuel load at takeoff (total fuel minus taxi fuel).

Trapped Fuel—The fuel remaining when the aircraft is defueled by normal means using the procedures and attitudes specified for draining the tanks.

Unusable Fuel—Fuel remaining after a fuel runout test has been completed in accordance with governmental regulations. It includes drainable unusable fuel plus trapped fuel.

Useful Load—Difference between maximum ramp weight and basic empty weight. It includes payload, usable fuel, and other usable fluids not included as standard items.

Usable Fuel—Fuel available for aircraft propulsion.

FORMS

The Weight-and-Balance forms are discussed below, and examples of the forms are included in Figures 19-1 through 19-11. If the aircraft has a different seating configuration from the one depicted in the example, the form appropriate to that configuration is in the *AFM*.

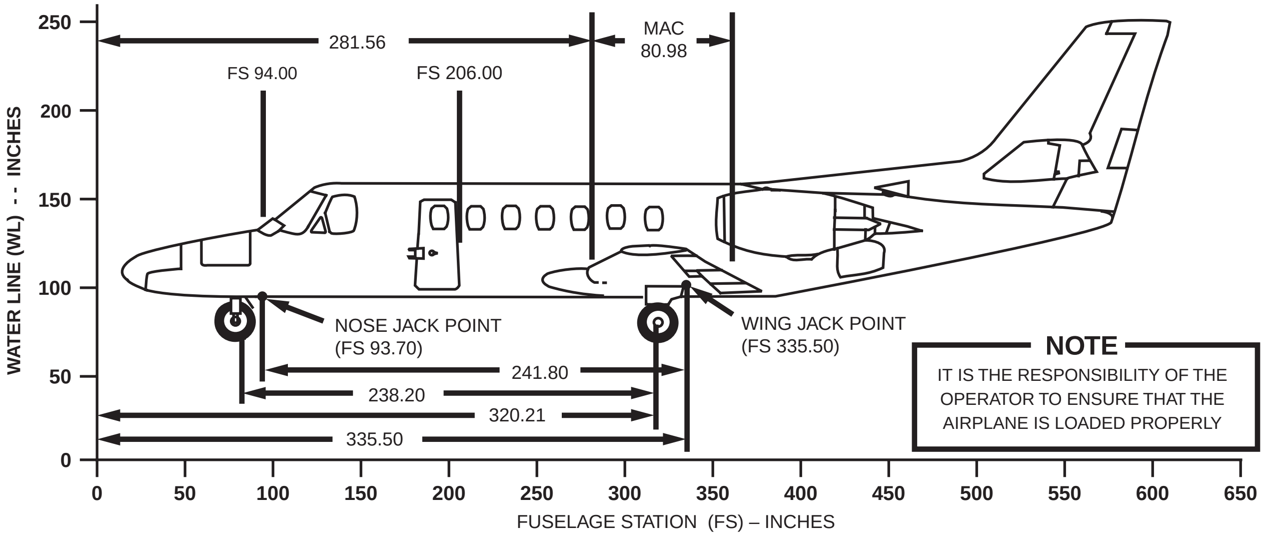
AIRPLANE WEIGHING FORM

Form 1905

The aircraft weight, CG arm, and moment (divided by 100) are all listed at the bottom of this form as the aircraft is delivered from the factory (Figure 19-1). Ensure that the basic empty weight figures listed are current and have not been amended.

SERIAL NUMBER ________ **REGISTRATION NUMBER** ________ **DATE** ________

AIRPLANE WEIGHING FORM



NOTE

IT IS THE RESPONSIBILITY OF THE OPERATOR TO ENSURE THAT THE AIRPLANE IS LOADED PROPERLY

LOCATING CG WITH AIRPLANE ON LANDING GEAR

FORMULA for Longitudinal CG

CG Arm of Airplane = 320.21 – $\dfrac{\text{238.20 x (Nose Landing Gear Net Weight)(\quad\quad)}}{\text{Nose and Main Landing Gear Weight Totaled (\quad\quad)}}$ = ( ) Inches Aft of Datum

LOCATING CG WITH AIRPLANE ON JACK PADS

FORMULA for Longitudinal CG

CG Arm of Airplane = 335.50 – $\dfrac{\text{241.80 x (Nose Jack Point Net Weight)(\quad\quad)}}{\text{Nose and Wing Jack Point Weight Totaled)(\quad\quad)}}$ = ( ) Inches Aft of Datum

LEVELING PROVISIONS

LONGITUDINAL – INBOARD SEAT TRACKS CENTER LEVEL OVER FS 221.00
LATERAL – INBOARD SEAT TRACKS AT FS 221.00

LOCATING PERCENT MAC

FORMULA for Percent MAC

CG Percent MAC = $\dfrac{\text{(CG Arm of Airplane) – 281.56}}{\text{0.8098}}$

AIRPLANE AS WEIGHED TABLE

POSITION	SCALE READING	SCALE DRIFT	TARE	NET WEIGHT
LEFT WING				
RIGHT WING				
NOSE				
AIRPLANE TOTAL AS WEIGHED				

BASIC EMPTY WEIGHT AND CENTER-OF-GRAVITY TABLE

ITEM	WEIGHT (POUNDS)	CG ARM (INCHES)	MOMENT (INCH-POUNDS/100)
AIRPLANE (CALCULATED OR AS WEIGHED) (INCLUDES ALL UNDRAINABLE FLUIDS AND FULL OIL)			
DRAINABLE UNUSABLE FUEL AT 6.75 POUNDS PER GALLON	19.20	305.50	58.66
BASIC EMPTY WEIGHT			

Figure 19-1. Airplane Weighing—Form 1905

WEIGHT-AND-BALANCE RECORD

The Weight-and-Balance Record amends the Airplane Weighing Form. After delivery, if a service bulletin is applied to the aircraft or if equipment is removed or added that would affect the CG or basic empty weight, it must be recorded on this form in the *AFM*. The crew must always have access to the current aircraft basic weight and moment in order to be able to perform weight and balance computations.

Crew and Passenger Compartments Weight and Moment Tables—U.S. Units

Form 1908

The tables already have computed moments/100 for weights in various seating locations in the aircraft (Figure 19-2).

BAGGAGE/CABINET COMPARTMENTS WEIGHT-AND-MOMENT TABLE

Form 1912

Notice in the cabinet and cargo compartments tables the last weight that a moment/100 is listed for under the nose compartment column is 310 pounds (Figure 19-3). This corresponds to the placard limit in that compartment. Remember that this limit is structural in nature. It is based on the maximum weight the flooring in that area can support. This same point applies to the aft cabin and tail cone compartments as well.

FUEL LOADING WEIGHT-AND-MOMENT TABLES

Form 1907

All of the tables have arms listed for the various locations except the fuel tables (Figure 19-4). Notice that the arm varies depending on the quantity of usable fuel.

CENTER-OF-GRAVITY MOMENT ENVELOPE GRAPH

After summing all the weights and moments, it is necessary to determine whether the CG is within allowable limits.

This graph represents the allowable CG envelope (Figure 19-5).

The way to plot the location of the CG on the graph is to determine the CG location in inches aft of datum, then plot it against the weight. To determine the CG arm, the total moment (moment x 100) is divided by the total aircraft weight.

WEIGHT AND BALANCE SAMPLE LOADING PROBLEM

Refer to Figures 19-6, 19-7, and 19-8 for a sample loading problem.

MODEL 560 *ULTRA*
CITATION V

WEIGHT AND BALANCE DATA

Cessna

SERIAL NUMBER ________ REGISTRATION NUMBER ________ DATE ________

CREW AND PASSENGER COMPARTMENTS WEIGHT AND MOMENT TABLES STANDARD

AIRPLANES 560-0260 AND ON

CREW AND PASSENGER SEATS

WEIGHT (POUNDS)	MOMENT/100						
	SEAT 1 AND SEAT 2 ARM = FS 132.70	SEAT 3 AND SEAT 4 ARM = FS 224.70	SEAT 5 AND SEAT 6 ARM = FS 274.24	SEAT 7 AND SEAT 8 ARM = FS 309.33	SEAT 9 ARM = FS 170.00	SEAT 10 ARM = FS 176.00	AFT FLUSHING TOILET ARM = FS 347.00
50	66.35	112.35	137.12	154.67	85.00	88.00	173.50
60	79.62	134.82	164.54	185.60	102.00	105.60	208.20
70	92.89	157.29	191.97	216.53	119.00	123.20	242.90
80	106.16	179.76	219.39	247.46	136.00	140.80	277.60
90	119.43	202.23	246.82	278.40	153.00	158.40	312.30
100	132.70	224.70	274.24	309.33	170.00	176.00	347.00
110	145.97	247.17	301.66	340.26	187.00	193.60	381.70
120	159.24	269.64	329.09	371.20	204.00	211.20	416.40
130	172.51	292.11	356.51	402.13	221.00	228.80	451.10
140	185.78	314.58	383.94	433.06	238.00	246.40	485.80
150	199.05	337.05	411.36	464.00	255.00	264.00	520.50
160	212.32	359.52	438.78	494.93	272.00	281.60	555.20
170	225.59	381.99	466.21	525.86	289.00	299.20	589.90
180	238.86	404.46	493.63	556.79	306.00	316.80	
190	252.13	426.93	521.06	587.73	323.00	334.40	
200	265.40	449.40	548.48	618.66	340.00	352.00	
210	278.67	471.87	575.90	649.59	357.00	369.60	
220	291.94	494.34	603.33	680.53	374.00	387.20	
230	305.21	516.81	630.75	711.46	391.00	404.80	
240	318.48	539.28	658.18	742.39	408.00	422.40	
250	331.75	561.75	685.60	773.33	425.00	440.00	
260	345.02	584.22	713.02	804.26	442.00	457.60	
270	358.29	606.69	740.45	835.19	459.00	475.20	
280	371.56	629.16	767.87	866.12	476.00	492.80	
290	384.83	651.63	795.30	897.06	493.00	510.40	
300	398.10	674.10	822.72	927.99	510.00	528.00	
310	411.37	696.57	850.14	958.92	527.00	545.60	
320	424.64	719.04	877.57	989.86	544.00	563.20	
330	437.91	741.51	904.99	1020.79	561.00	580.80	
340	451.18	763.98	932.42	1051.72	578.00	598.40	

* NOTE: SEAT 9 MAY BE INSTALLED IN PLACE OF A FORWARD REFRESHMENT CENTER.

* * NOTE: THESE LOCATIONS INDICATE BAGGAGE AREA.

* * * NOTE: THIS LOCATION INDICATES A STORAGE AREA.

CREW AND PASSENGER MOMENT ARMS

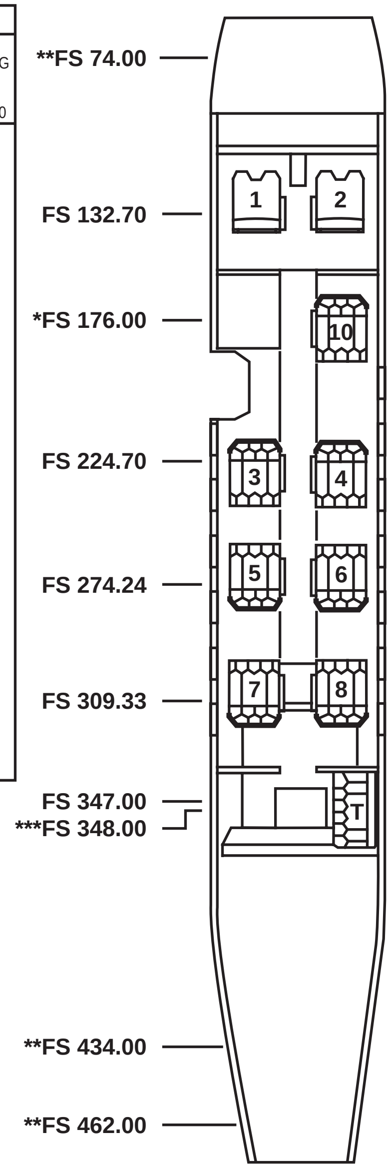


Figure 19-2. Crew/Passenger Weight-and-Moment Table/Standard—Form 1908

MODEL 560 *ULTRA*
CITATION V

WEIGHT AND BALANCE DATA

Cessna

Serial Number ________ **REGISTRATION NUMBER** ________ **DATE** ________

BAGGAGE AND CABINET COMPARTMENTS WEIGHT AND MOMENT TABLES

AIRPLANES 560-0260 AND ON

BAGGAGE AND STORAGE COMPARTMENT(S) CONTENTS

WEIGHT (POUNDS)	MOMENT/100			
	NOSE COMPARTMENT ARM = FS 74.00	CABIN COMPARTMENT ARM = FS 348.00	TAILCONE COMPARTMENT ARM = FS 434.00	TAILCONE COMPARTMENT ARM = FS 462.00
20	14.80	69.60	86.80	92.40
40	29.60	139.20	173.60	184.80
60	44.40	208.80	260.40	277.20
80	59.20	278.40	347.20	369.60
100	74.00	348.00	434.00	462.00
120	88.80	417.60	520.80	554.40
140	103.60	487.20	607.60	646.80
160	118.40	556.80	694.40	739.20
180	133.20	626.40	781.20	831.60
200	148.00	696.00	868.00	924.00
220	162.80	765.60	954.80	
240	177.60	835.20	1041.60	
260	192.40	904.80	1128.40	
280	207.20	974.40	1215.20	
300	222.00	1044.00	1302.00	
320	236.80	1113.60		
340	251.60	1183.20		
350	259.00	1218.00		
360		1252.80		
380		1322.40		
400		1392.00		
420		1461.60		
440		1531.20		
460		1600.80		
480		1670.40		
500		1740.00		
520		1809.60		
540		1879.20		
560		1948.80		
580		2018.40		
600		2088.00		

CHART CASES

WEIGHT (POUNDS)	MOMENT/100 ARM = FS 151.90
5	7.60
10	15.19
15	22.78

RIGHT SLIM LINE REFRESHMENT CENTER OR CLOSET CONTENTS

WEIGHT (POUNDS)	MOMENT/100 ARM = FS 158.00
5	7.90
10	15.80
15	23.70
20	31.60
25	39.50
30	47.40
35	55.30

DELUXE REFRESHMENT CENTER

WEIGHT (POUNDS)	MOMENT/100 ARM = FS 165.70
10	16.57
20	33.14
30	49.71
40	66.28
50	82.85
60	99.42
70	115.99
80	132.56
90	149.13
100	165.70

MIDSHIP CABINET CONTENTS

WEIGHT (POUNDS)	MOMENT/100 ARM = FS 244.20
5	12.21
10	24.42
15	36.63
20	48.84
25	61.05
30	73.26

AFT VANITY CABINET

WEIGHT (POUNDS)	MOMENT/100 ARM = FS 357.00
5	17.85
10	35.70
15	53.55
20	71.40
25	89.25
30	107.10
35	124.95

Figure 19-3. Baggage and Cabinet Weight-and-Moment Table—Form 1912

MODEL 560 *ULTRA*
CITATION V

WEIGHT AND BALANCE DATA

SERIAL NUMBER ________ REGISTRATION NUMBER ________ DATE ________

FUEL LOADING WEIGHT AND MOMENT TABLE

WING TANK FUEL

WEIGHT (POUNDS)	MOMENT/100 ARM VARIES (INCH-POUNDS)
100	306.20
200	604.76
300	910.80
400	1211.00
500	1509.75
600	1808.40
700	2105.25
800	2402.40
900	2699.50
1000	2996.50
1100	3296.15
1200	3596.40
1300	3895.45
1400	4195.80
1500	4495.95
1600	4796.32
1700	5096.94
1800	5397.66
1900	5699.62
2000	6001.00
2100	6302.73
2200	6603.96
2300	6906.67
2400	7207.20
2500	7509.00
2600	7810.66
2700	8113.50
2800	8414.56
2900	8717.11
3000	9018.60

WING TANK FUEL (CONTINUED)

WEIGHT (POUNDS)	MOMENT/100 ARM VARIES (INCH-POUNDS)
3100	9321.08
3200	9623.04
3300	9925.74
3400	10231.28
3500	10530.10
3600	10832.40
3700	11137.00
3800	11441.80
3900	11746.80
4000	12051.60
4100	12358.63
4200	12666.78
4300	12973.96
4400	13281.40
4500	13590.00
4600	13896.60
4700	14207.16
4800	14515.20
4900	14822.50
5000	15132.50
5100	15440.25
5200	15749.24
5300	16057.94
5400	16367.40
5500	16676.00
5600	16984.80
5700	17292.66
5800	17600.10
5814	17643.16

Figure 19-4. Fuel Loading Weight-and-Moment Table—Form 1907

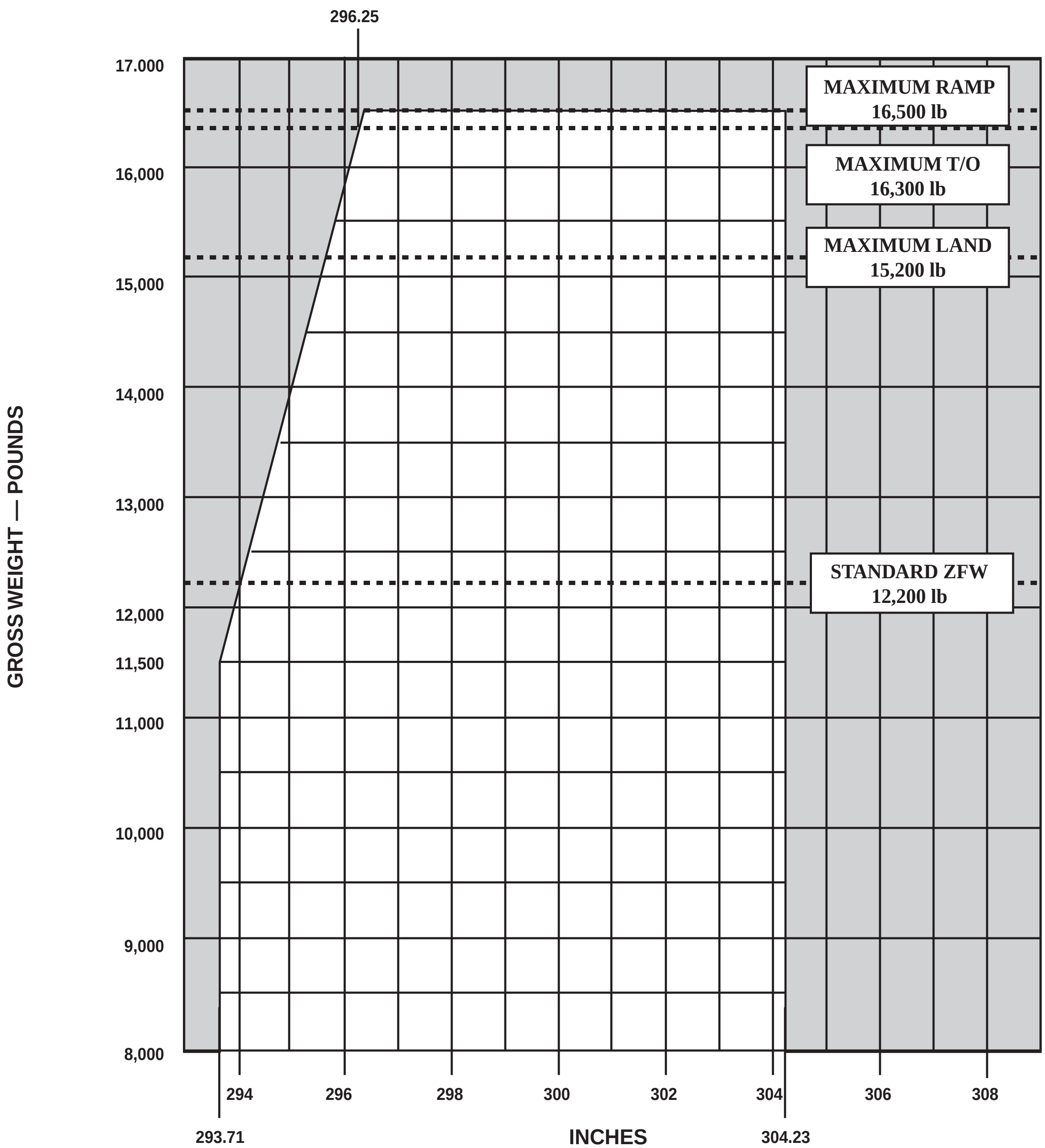


Figure 19-5. Center-of-Gravity Moment Envelope Graph

Citation V Ultra

Weight and Balance

Sample Loading Problem

Figure 19-6. Weight-and-Balance Sample Loading Problem Cover

1 **The first step in completing weight-and-balance computation is to determine the total weight and moment of the payload. This is accomplished using the left portion of the worksheet.**

The pilot and copilot always occupy seats 1 and 2. Other passengers are seated according to the seating chart provided by Cessna or based upon personal preference.

The Arms for each passenger and cargo location are determined by referring to the loading charts provided by Cessna.

Passenger weights are entered based on the actual weights. Average weights may also be used for each passenger.

The Moment for each passenger can be determined by reference to the loading charts provided by Cessna or by multiplying the weight times the Arm for each passenger and item of cargo

1 **Calculate Payload Weight and Moment**

ITEM	ARM (INCHES)	WEIGHT (POUNDS)	MOMENT/100
OCCUPANTS	**560 Ultra**		
Pilot	**131.00**	**180**	**238.80**
Copilot	**131.00**	**160**	**212.30**
Seat 3	**224.70**	**180**	**404.40**
Seat 4	**224.70**	**200**	**449.40**
Seat 5	**274.24**	**140**	**383.90**
Seat 6	**274.24**	**150**	**413.16**
Seat ___			
Seat ___			
Seat ___			
Seat ___			
Toilet	**345.79**		
BAGGAGE			
Nose	**74.00**	**50**	**37.00**
Tailcone	**434.00**	**100**	**434.00**
Tailcone	**462.00**		
Tube	**489.00**		
Cabin	**348.00**		
Cabinet Contents			
PAYLOAD		**1,160**	**2,571.34**

By convention, the moment is divided by 100. This provides "shorter" numbers that fit in small spaces. For example, the actual moment for Seat 4 is 37,762 inch-pounds (223.13 in. x 170 lb.).

Items of cargo may be located in the nose compartment, cabin, or tail cone. There are specific weight restrictions for each location. The loading charts indicate the maximum weight that is allowed in each location.

Placement of cargo should not be done haphazardly. Cargo should be secured and located to provide the most favorable center of gravity location.

The weights and moments of the pilots, passengers, and cargo are added to determine the total payload weight and moment. The totals are then copied to the Weight-and-Balance Worksheet.

Figure 19-7. Weight-and-Balance Worksheet—Sample Loading Problem (Sheet 1 of 4)

2 THE SECOND STEP IS TO DETERMINE THE ZERO FUEL WEIGHT, MOMENT

BASIC EMPTY WEIGHT
From the aircraft records copy the Basic Empty Weight (BEW) and Moment in the space provided on the worksheet.

PAYLOAD
From the payload worksheet copy the total payload weight and moment onto the Payload line in the spaces provided.

ZERO FUEL WEIGHT
Add the Basic Empty Weight and the Payload weight. This is the Zero Fuel Weight (ZFW). Enter the number in the space provided.

Add the moment of the empty aircraft to the payload moment. Enter the total in the space provided.

Divide the ZFW moment by the zero fuel weight. The ZFW Arm must be within the aft boundary of the envelope.

2 Calculate Zero Fuel Weight, Moment and CG

Item	Weight	MOM/100
Basic Empty Weight ***or*** **Basic Operating Weight**	9,400	28,942.2
+ ***Payload***	1,160	2,571.0
Zero Fuel Weight *	10,560	31,513.5

$$\frac{\textbf{ZFW MOM}}{\textbf{Zero Fuel Weight}} = \boxed{298.0}$$ **ZFW CG**

3 THE THIRD STEP IS TO ADD THE TOTAL FUEL LOAD AND FIND THE RAMP WEIGHT.

TOTAL FUEL LOAD
Enter the total fuel load in the space provided.

RAMP WEIGHT
Add the zero fuel weight and the total fuel load. The result is the Ramp Weight.

3 Calculate Fuel Load and Ramp Weight

Item	Weight
Zero Fuel Weight *	10,560
+ ***Flight Fuel***	3,200
+ ***Reserve Fuel***	1,000
Ramp Weight	14,760

Note:
The Zero Fuel Weight (ZFW) and the Ramp Weight may not exceed the certified limits.

If the Zero Fuel Weight exceeds the certified limit, passengers or cargo must be removed to reduce the weight.

If the Ramp Weight exceeds the certified limit, either the fuel load or the payload must be reduced.

Figure 19-7. Weight-and-Balance Worksheet—Sample Loading Problem (Sheet 2 of 4)

4 THE FOURTH STEP IS TO DETERMINE THE TAKEOFF WEIGHT, MOMENT

TAKEOFF FUEL
Enter the takeoff fuel weight. (Total Fuel Load minus 200 lb.)

Using the fuel loading chart provided by Cessna, determine the moment for the takeoff fuel weight.

TAKEOFF WEIGHT
Add the takeoff fuel weight and the zero fuel weight. The takeoff weight must be less than the certified limit.

Add the takeoff fuel moment and the zero fuel weight moment.

Divide the takeoff moment by the takeoff weight. The result is the takeoff arm. The takeoff arm must be within the envelope limits.

5 THE FIFTH STEP IS TO DETERMINE THE LANDING WEIGHT.

LANDING FUEL
Enter the projected landing fuel in the space provided.

LANDING WEIGHT
Add the landing fuel and the zero fuel weight. The landing weight must not exceed certified limits.

4 Calculate Takeoff Fuel

Total Fuel 4,200
–Taxi Fuel 200
Takeoff Fuel 4,000

5 Calculate Takeoff Weight, Moment and CG

Item	Weight	MOM/100
Zero Fuel Weight *	10,560	31,513.58
+ *Takeoff Fuel*	4,000	12,051.60
Takeoff Weight	14,560	43,565.18

$\frac{\text{Takeoff MOM}}{\text{Takeoff Weight}}$ = 299.2 Takeoff CG

6 Calculate Landing Weight

Item	Weight
Zero Fuel Weight *	10,560
+ *Reserves*	1,000
Landing Weight	11,560

7

* See limitations on reverse.

Figure 19-7. Weight-and-Balance Worksheet—Sample Loading Problem (Sheet 3 of 4)

Citation 560/Ultra

1 Calculate Payload Weight and Moment

Item	Arm	Weight	MOM/100
	560 Ultra		
Pilot	131.00 132.70	180	238.86
Copilot	131.00 132.70	160	212.32
Seat 3	224.70	180	404.46
Seat 4	224.70	200	449.40
Seat 5	274.24	140	383.94
Seat 6	274.24	150	411.36
Seat__			
Seat__			
Seat__			
Seat__			
Toilet	345.00 347.00		
Nose	74.00	50	37.0
Cabin	348.00		
Tailcone (Fwd)	434.00	100	434.0
Tailcone (Aft)	462.00		
Payload		1,160	2,571.34

LOADING INFORMATION	
TOTAL FUEL	4,200 LB
PILOT	180 LB
COPILOT	160 LB
PASSENGER	180 LB
PASSENGER	200 LB
PASSENGER	140 LB
PASSENGER	150 LB
PASSENGER'S BAGGAGE	100 LB
CARGO PACKAGE	50 LB

2 Calculate Zero Fuel Weight, Moment and CG

Item	Weight	MOM/100
Basic Empty Weight *or* Basic Operating Weight	9,400	28,942.24
+*Payload*	1,160	2,571.34
Zero Fuel Weight *	10,560	31,513.58

$\frac{\text{ZFW MOM}}{\text{Zero Fuel Weight}}$ = 298.4 ZFW CG

3 Calculate Fuel Load and RampWeight

Item	Weight
Zero Fuel Weight *	10,560
+ *Flight Fuel*	3,200
+ *Reserve Fuel*	1,000
Ramp Weight	14,760

4 Calculate Takeoff Fuel

Total Fuel 4,200
- Taxi Fuel 200
Takeoff Fuel 4,000

5 Calculate Takeoff Weight, Moment and CG

Item	Weight	MOM/100
Zero Fuel Weight *	10,560	31,513.18
+ *Takeoff Fuel*	4,000	12,051.60
Takeoff Weight	14,560	43,565.18

$\frac{\text{Takeoff MOM}}{\text{Takeoff Weight}}$ = 299.2 Takeoff CG

6 Calculate Landing Weight

Item	Weight
Zero Fuel Weight *	10,560
+ *Reserves*	1,000
Landing Weight	11,560

7

* See limitations on reverse.

Figure 19-7. Weight-and-Balance Worksheet—Sample Loading Problem (Sheet 4 of 4)

Citation 560/Ultra

1 Calculate Payload Weight and Moment

Item	Arm	Weight	MOM/100
	560 Ultra		
Pilot	131.00 132.70		
Copilot	131.00 132.70		
Seat__			
Seat__			
Seat__			
Seat__			
Seat__			
Seat__			
Seat__			
Seat__			
Toilet	345.00 347.00		
Nose	74.00		
Cabin	348.00		
Tailcone (Fwd)	434.00		
Tailcone (Aft)	462.00		
Payload			

LOADING INFORMATION

TOTAL FUEL	4,200 LB
PILOT	180 LB
COPILOT	160 LB
PASSENGER	180 LB
PASSENGER	200 LB
PASSENGER	140 LB
PASSENGER	150 LB
PASSENGER'S BAGGAGE	100 LB
CARGO PACKAGE	50 LB

2 Calculate Zero Fuel Weight, Moment and CG

Item	Weight	MOM/100
Basic Empty Weight *or* Basic Operating Weight		
+Payload		
Zero Fuel Weight *		

$\frac{\text{ZFW MOM}}{\text{Zero Fuel Weight}} = \boxed{}$ ZFW CG

3 Calculate Fuel Load and Ramp Weight

Item	Weight
Zero Fuel Weight *	
+ Flight Fuel	
+ Reserve Fuel	
Ramp Weight	

4 Calculate Takeoff Fuel

Total Fuel
- Taxi Fuel
Takeoff Fuel

5 Calculate Takeoff Weight, Moment and CG

Item	Weight	MOM/100
Zero Fuel Weight *		
+ Takeoff Fuel		
Takeoff Weight		

$\frac{\text{Takeoff MOM}}{\text{Takeoff Weight}} = \boxed{}$ Takeoff CG

6 Calculate Landing Weight

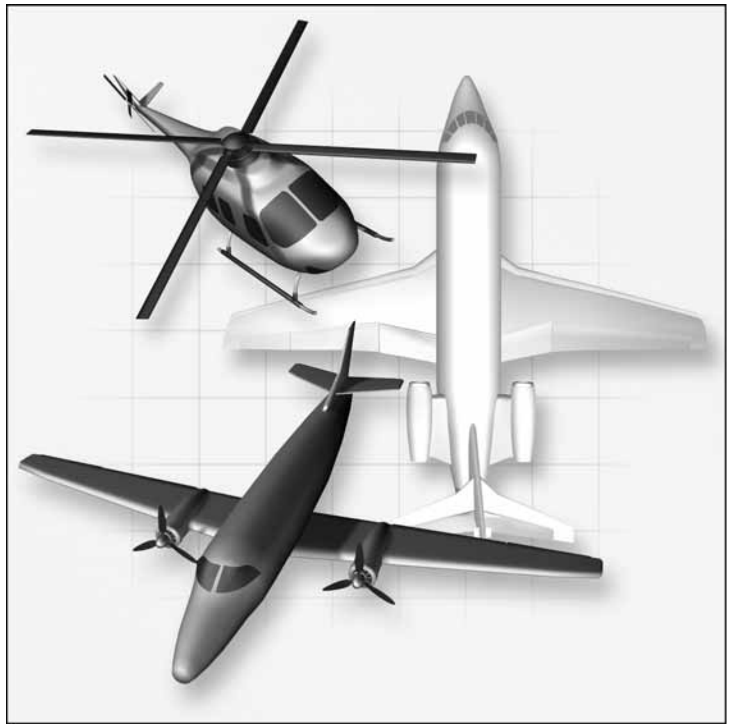
Item	Weight
Zero Fuel Weight *	
+ Reserves	
Landing Weight	

7

* See limitations on reverse.

Figure 19-8. Weight-and-Balance Worksheet

CHAPTER 20
FLIGHT PLANNING AND PERFORMANCE



SECTION VII

FLIGHT PLANNING AND PERFORMANCE

CONTENTS

WEIGHT AND BALANCE

The center-of-gravity (CG) of an airplane can be defined as the point on the longitudinal axis about which the airplane would balance. The force of weight always acts through the center-of-gravity. The forces of lift attempt to rotate the airplane about the center-of-gravity.

In flight, the forces of gravity and lift from the wing and horizontal stabilizer must balance about the center-of-gravity so that stability is achieved.

CENTER-OF-GRAVITY FORCES

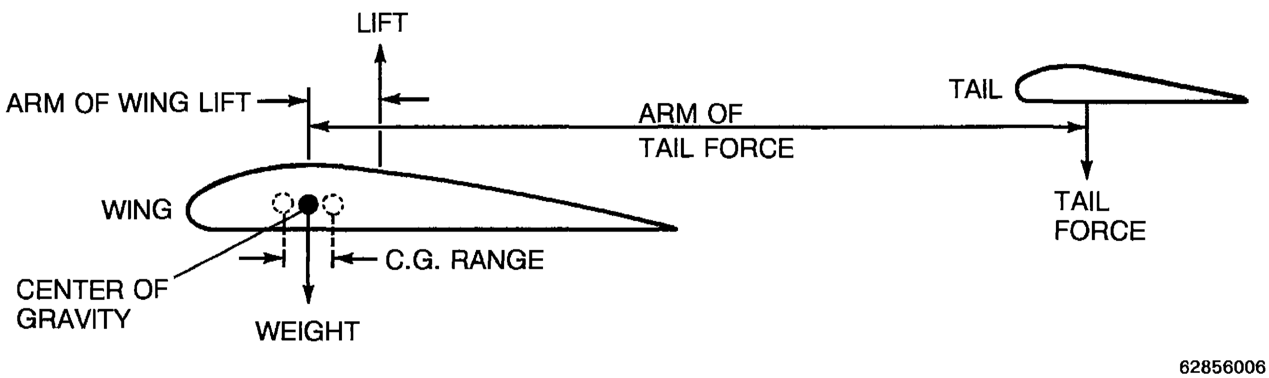


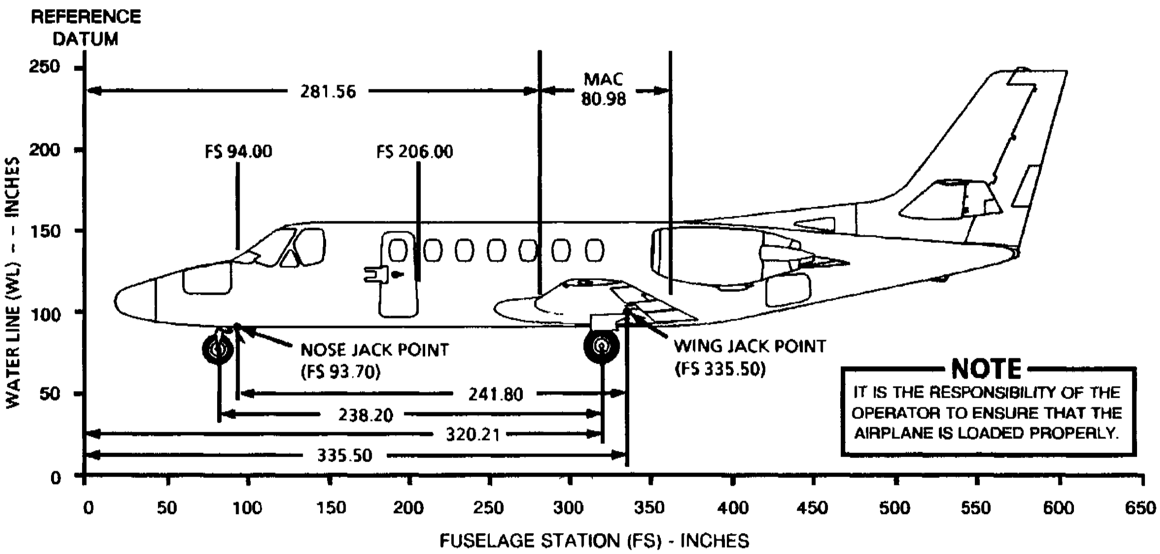
Figure 7-1. Center-Of-Gravity Forces

As the center-of-gravity changes forward or aft due to airplane loading, the lever or moment arm of the wing and tail lifting surfaces changes.

The horizontal stabilizer must be capable of providing an equalizing moment to that which is produced by the remainder of the airplane. Since the amount of lift produced by the horizontal stabilizer is limited, the range of movement of the center-of-gravity is restricted so that equilibrium can be maintained. Loading must be calculated as being within the allowable envelope to achieve proper stability and control.

The center-of-gravity of an empty airplane is found by accurate weighing to determine the balance point. This point is then defined by labeling it in inches aft of a fixed reference line located forward of the airplane nose. This line is called the Reference Datum Line. Selection of the Reference Datum line is arbitrary, but it does provide a standard from which center-of-gravity movement along the longitudinal axis can be measured.

AIRPLANE WEIGHING INFORMATION



FORM NUMBER 1905, 16 May 1994

Figure 7-2. Airplane Weighing Information

At maximum gross weight, the center-of-gravity of a loaded airplane can move from 296.03 inches to 304.23 inches aft of Datum and remain within limits.

As the airplane is loaded, the center-of-gravity will shift. The amount of shift is dependent on not only the weight added, but the distance the weight is placed from the original center-of-gravity. Both of these factors can be considered by multiplying the weight added by the distance from the Reference Datum Line to produce the loading moment. This information is presented in table form in the Crew and Passenger, Cabinet, Baggage and Fuel Loading Moments tables.

The contribution each load station makes to center-of-gravity shift can be seen by comparing the respective center-of-gravity arm lengths given in the Weight and Moment Table. Any weight placed in the aft baggage bay will shift the center-of-gravity aft since it is aft of the typical standard empty weight center-of-gravity.

Adding fuel, passengers or baggage (in the nose compartment) will shift the center-of-gravity forward since all of them are loaded forward of the typical standard empty weight center-of-gravity. The magnitude of the shift for any given weight is proportional to the length of the moment arm.

PAYLOAD COMPUTATIONS

ITEM	ARM	WEIGHT (POUNDS)	MOMENT/ 100
OCCUPANTS			
SEAT 1	132.70	170	225.60
SEAT 2	132.70	170	225.60
SEAT 3	224.70	170	382.00
SEAT 4	224.70	170	382.00
SEAT 5	274.70	170	466.10
SEAT 6	274.70	170	466.10
SEAT 7	309.30	170	525.80
SEAT __			
SEAT __			
SEAT __			
TOILET	347.00		
BAGGAGE			
NOSE	74.00	100	74.00
TAILCONE	434.00	300	1302.00
TAILCONE	462.00		
STORAGE			
CABIN	348.00		
CABINET CONTENTS			
PAYLOAD		1590	4049.25

ITEM	WEIGHT (POUNDS)	MOMENT/ 100
1. BASIC EMPTY WEIGHT * Airplane CG = 310.00	9400	29,140.00
2. PAYLOAD	1590	4049.25
3. ZERO FUEL WEIGHT (sub-total) (Do not exceed maximum zero fuel weight of 12,200 pounds (standard))	10,990	33,189.25
4. FUEL LOADING	5424	16,441.46
5. RAMP WEIGHT (sub-total) (Do not exceed maximum ramp weight of 16,500 pounds	16,414	49,630.71
6. LESS FUEL FOR TAXIING	200	618.14
7.** TAKEOFF WEIGHT (Do not exceed maximum takeoff weight of 16,300 pounds) ** Airplane CG = 302.29 ***	*** 16,214	49,012.57
8. LESS FUEL FOR DESTINATION	2000	6127.63
9.** LANDING WEIGHT (Do not exceed maximum landing weight of 15,200 pounds) * Airplane CG = 301.71 ***	*** 14,214	42,884.94

$$* \text{ Airplane CG} = \frac{\text{MOMENT/100}}{\text{WEIGHT}} \times 100$$

** Totals must be within approved weight and center-of-gravity limits. It is the responsibility of the operator to ensure that the airplane is loaded properly.
The Basic Empty Weight CG is noted on the Airplane Weighing Form. If the airplane has been altered, refer to the Weight and Balance Record for information.

*** Enter on the Center-of-Gravity Limits Envelope Graph to check if within approved limites (shaded area).

FORM NUMBER 1913-X1, 16 May 1994

Figure 7-3. Weight and Balance Form

FUEL LOADING WEIGHT AND MOMENT TABLE

WING TANK FUEL

WEIGHT (POUNDS)	MOMENT/100 ARM VARIES (INCH-POUNDS)
100	306.20
200	604.76
300	910.80
400	1211.00
500	1509.75
600	1808.40
700	2105.25
800	2402.40
900	2699.50
1000	2996.50
1100	3296.15
1200	3596.40
1300	3895.45
1400	4195.80
1500	4495.95
1600	4796.32
1700	5096.94
1800	5397.66
1900	5699.62
2000	6001.00
2100	6302.73
2200	6603.96
2300	6906.67
2400	7207.20
2500	7509.00
2600	7810.66
2700	8113.50
2800	8414.56
2900	8717.11
3000	9018.60

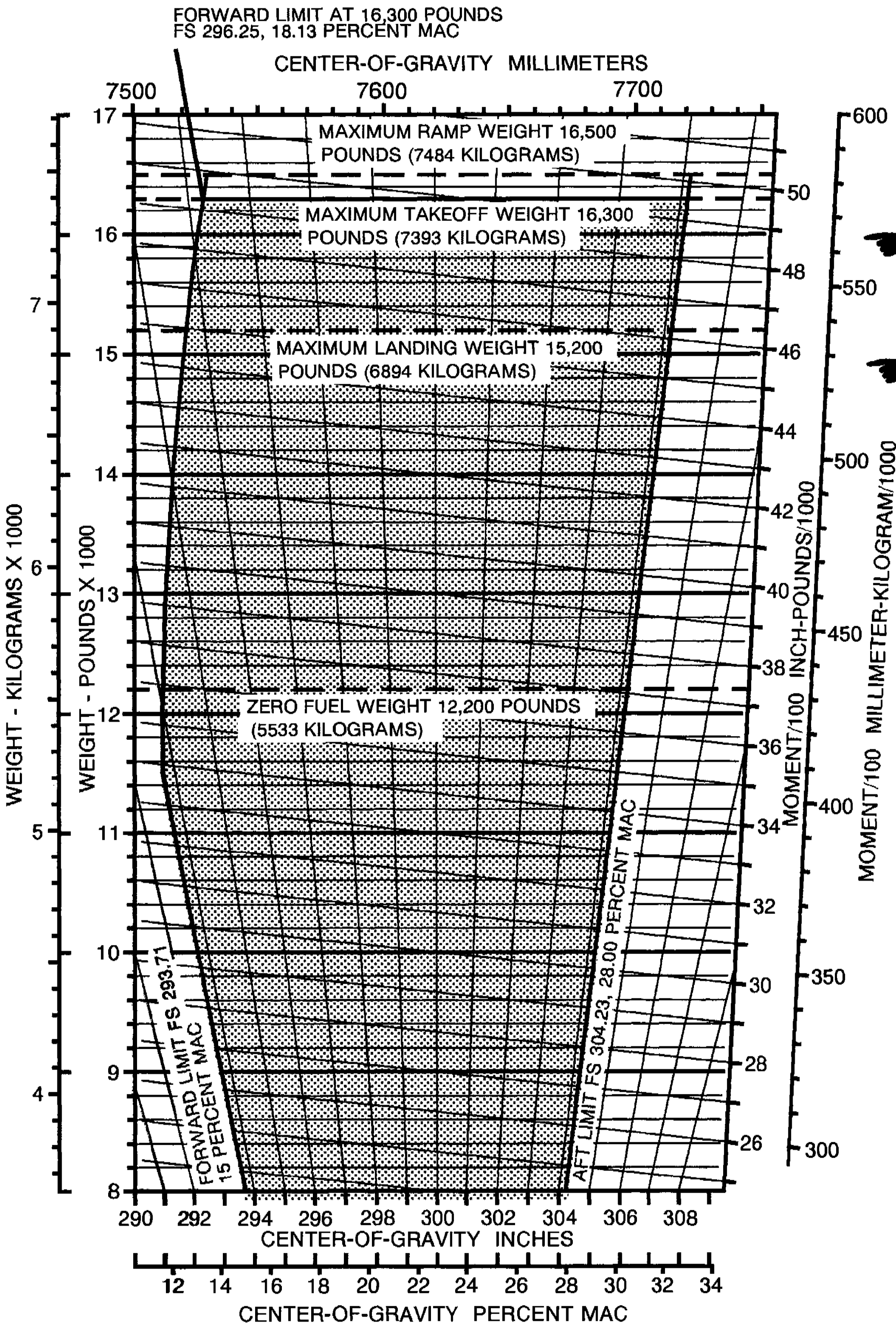
WING TANK FUEL (CONTINUED)

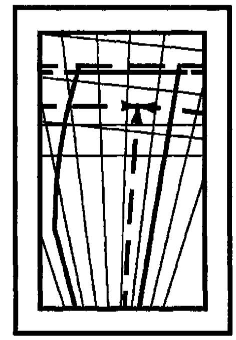
WEIGHT (POUNDS)	MOMENT/100 ARM VARIES (INCH-POUNDS)
3100	9321.08
3200	9623.04
3300	9925.74
3400	10231.28
3500	10530.10
3600	10832.40
3700	11137.00
3800	11441.80
3900	11746.80
4000	12051.60
4100	12358.63
4200	12666.78
4300	12973.96
4400	13281.40
4500	13590.00
4600	13896.60
4700	14207.16
4800	14515.20
4900	14822.50
5000	15132.50
5100	15440.25
5200	15749.24
5300	16057.94
5400	16367.40
5500	16676.00
5600	16984.80
5700	17292.66
5800	17600.10
5814	17643.16

FORM NUMBER 1772-3, 1 February 1989

Figure 7-4. Fuel Loading Weight and Moment Table

CENTER-OF-GRAVITY LIMITS ENVELOPE

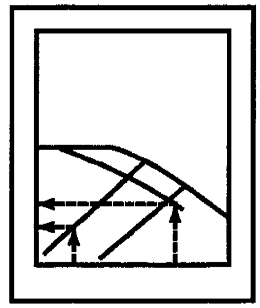




FORM NUMBER 1906, 16 May 1994

Figure 7-5. Center-of-Gravity Limits Envelope

MULTIENGINE NORMAL CLIMB



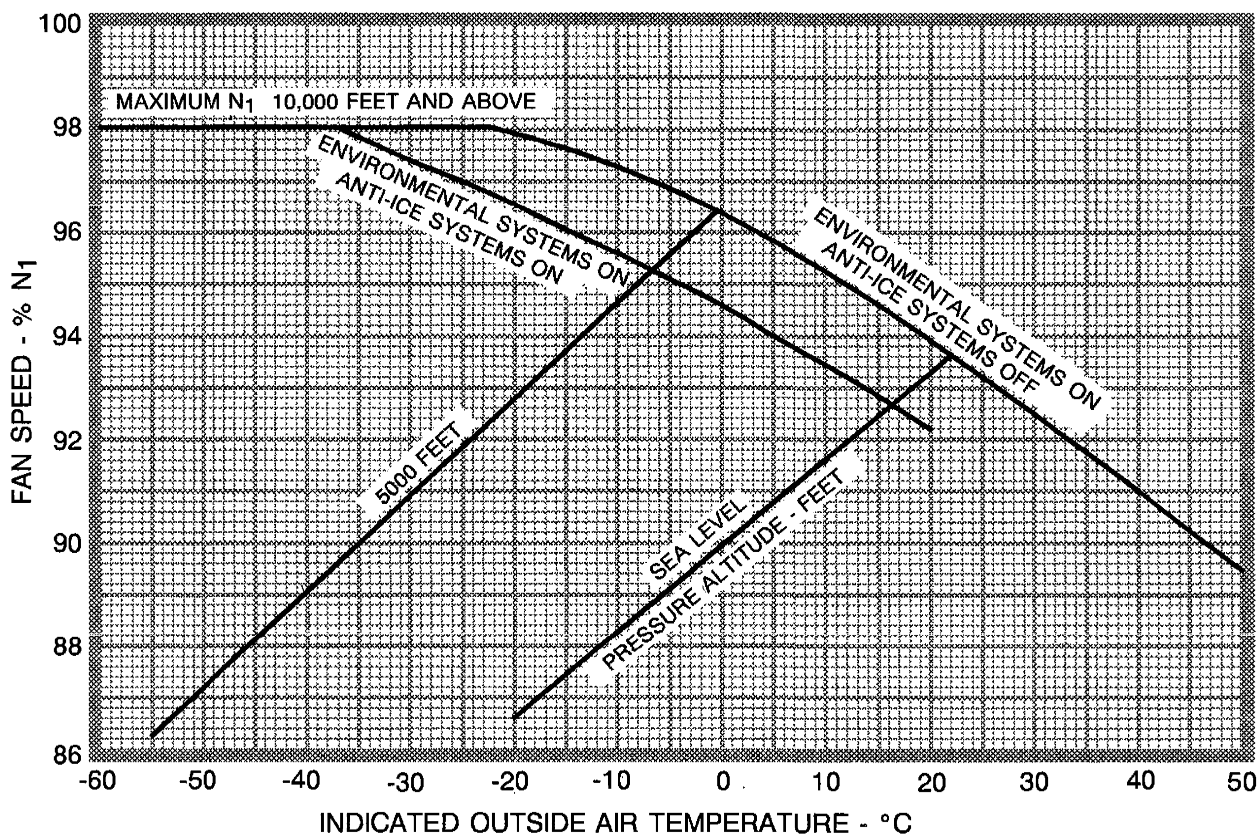


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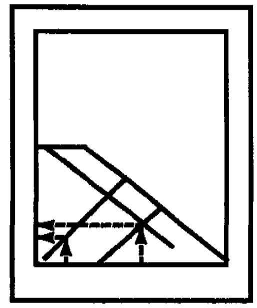
Figure 7-6. Multiengine Normal Climb

MAXIMUM CRUISE THRUST SETTING



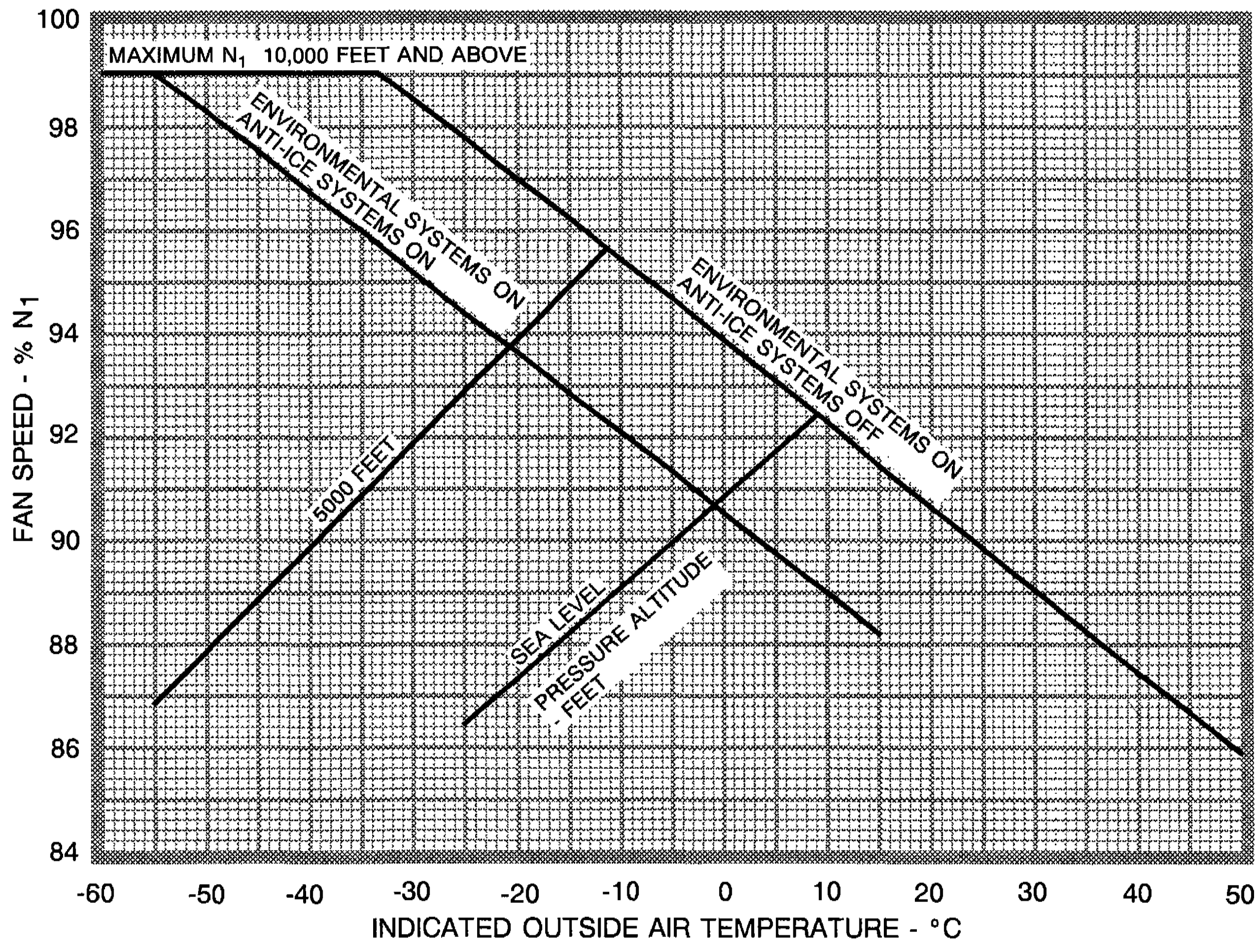


Figure 7-7. Maximum Cruise Thrust Setting

FLIGHT PLANNING

Thorough flight planning suggests establishing a preflight goal such as maximum range, minimum time enroute, or maximum fuel reserve within the parameters defined by the Airplane Flight Manual takeoff, climb and landing requirements. Graphs for Maximum Cruise Thrust, 92 percent N_1, and Long Range Cruise are presented in this chapter to aid the crew in determining how best to achieve that goal. Maximum cruise thrust results in minimum time, long range cruise at optimum fuel consumption and 92 percent N_1 represents a balance between the two.

Maximum range at a given altitude is dependent upon airframe efficiency and can be defined in still air as that point on the total drag curve where the relationship of velocity to total airplane drag is most favorable. The cruise angle-of-attack necessary to achieve that point is constant, but airspeed required is affected by airplane weight. The higher the weight, the higher the airspeed necessary to achieve optimum cruise angle-of-attack. This is in evidence when the long range cruise FLIGHT PLANNING graphs are used and result in longer block times for the lighter weights. Enroute, as fuel burnoff occurs, thrust and airspeed required for best range will decrease as specific range increases due to improved performance at the lower operating weights. This should be considered when planning short stage lengths to avoid carrying excessive weight in stored fuel not operationally necessary.

Wind existing at cruise altitudes requires a more involved planning process to realize best range because it requires a true airspeed faster or slower than that at which optimum range angle-of-attack is achieved in still air. This minimizes the effects of a headwind, or takes maximum advantage of a tailwind. The airplane's broad altitude capability also brings into consideration engine efficiency. Since the fuel flow necessary for a given true airspeed decreases with an increase in altitude, a higher headwind component may be tolerated at the upper flight level with best results in terms of ground distance covered to fuel consumed. Conversely, large increases in headwind velocity with altitude may dictate a lower cruise level to obtain the best fuel to distance relationship.

To assist altitude selection taking into account upper winds, SPECIFIC RANGE vs CRUISE WIND tables are presented for maximum cruise thrust, 92 percent N_1, and long range cruise. Their purpose is to provide a comparative reference for determining the best altitude/wind combination to achieve a maximum range goal. They also illustrate the increase in engine efficiency with altitude.

SPECIFIC RANGE VS CRUISE WIND

Entering with forecast winds, the TABLE is read vertically until cruise altitude is intersected. The table gives specific range in a fraction of a nautical mile per pound of fuel consumed. Moving the decimal two or three places to the right gives distance per 100 and 1000 pounds of fuel respectively. In comparative calculations, the highest number always represents best specific range. The long range cruise mode will generally result in optimum specific range, but high headwinds may suggest an increased power setting to realize a shorter trip time without affecting total fuel burn appreciably. At 35,000 feet with an 80-knot headwind, as an example, long range cruise and maximum cruise thrust give .277 and .223 nautical miles/pounds, respectively. In that case, long range cruise will produce only 54 nautical miles more distance per 1000 pounds of fuel while the ground speed at maximum cruise thrust would be approximately 75 knots faster. However, for the absolute best range or maximum fuel reserve goal, cruising at the altitude/wind/thrust combination with the highest specific range number will produce optimum results.

Climb and descent at maximum speed available to achieve desired vertical rate can be used in conjunction with maximum cruise thrust for the minimum time goal. Fuel economy, however, is better served by using the climb and descent schedules presented in the PERFORMANCE chapter of this section.

Once the cruise mode and altitude have been determined, enroute time and fuel required can be approximated from the appropriate FLIGHT PLANNING graphs.

The following criteria are used:

1. 200 pounds of taxi fuel.
2. Multiengine climb schedule.
3. Sixty percent of the cruise wind factor applied to climb; 40 percent to descent.
4. Descent to 10,000 feet from cruise altitude at 2000 feet per minute using 800 pounds per hour fuel flow.
5. Thirty nautical miles from destination at 10,000 feet and long range cruise airspeed.
6. Ten minutes approach fuel at 1020 pounds per hour total fuel flow.

FLIGHT PLANNING

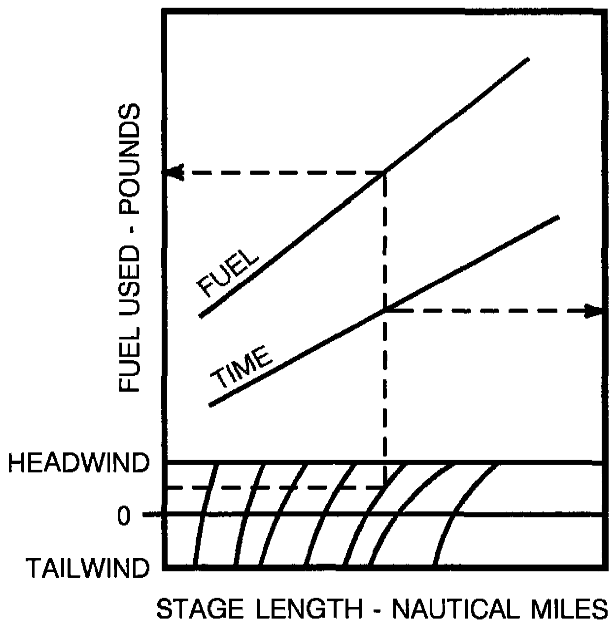


Figure 7-8. Flight Planning

Enter the graph with the headwind or tailwind component at cruise altitude. Read right until intersecting planned stage length and then up to the time line. Time will vary with gross weight so, in most instances, two time lines are shown. Interpolate for gross weights between 12,000 and 16,300 pounds. Trip time is given in hours and minutes on the scale to the right of the graph.

To find trip fuel, continue vertically until intersecting the fuel line. Again, fuel used may vary with gross weight. Interpolate as necessary for gross weights between 12,000 and 16,300 pounds. Total fuel used in pounds is given on the scale to the left of the graph. Reserve fuel requirements can then be added to total fuel used to determine takeoff and landing fuel loads.

If the fuel required is in excess of fuel available or if fuel reserves are inadequate, it may be advantageous to utilize one of the more economical cruise airspeed profiles and repeat the flight planning process. Specific data is presented in the PERFORMANCE chapter for separate computation of the climb, cruise and descent phases. If taxi time is known, 10 pounds per minute fuel flow can be used in lieu of the 200-pound figure.

After airplane loading and flight plan fuel requirements are determined, takeoff, climb and landing gross weights should be rechecked for compliance with the airplane flight manual criteria.

SPECIFIC RANGE VS CRUISE WIND
MAXIMUM CRUISE THRUST
STANDARD DAY

SPECIFIC RANGE - NAUTICAL MILES PER POUND OF FUEL																	
			TAILWIND - KNOTS								HEADWIND - KNOTS						
PRESS	AVERAGE		140	120	100	80	60	40	20	ZERO	20	40	60	80	100	120	140
ALT FEET	CRUISE WT-LBS	N1 %RPM	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE
19000	13500	91.1	.273	.262	.252	.241	.231	.220	.210	.200	.189	.179	.168	.158	.147	.137	.126
23000	13500	94.1	.281	.270	.260	.250	.239	.229	.219	.209	.198	.188	.178	.167	.157	.147	.136
27000	13500	96.5	.293	.283	.272	.262	.251	.241	.231	.220	.210	.199	.189	.178	.168	.158	.147
31000	13500	97.6	.326	.315	.303	.292	.280	.269	.257	.246	.234	.223	.211	.199	.188	.176	.165
33000	13500	98.2	.344	.332	.320	.308	.296	.284	.272	.259	.247	.235	.223	.211	.199	.187	.175
35000	13500	98.8	.364	.351	.338	.325	.313	.300	.287	.274	.261	.249	.236	.223	.210	.198	.185
37000	13500	99.0	.392	.378	.364	.350	.337	.323	.309	.295	.281	.267	.254	.240	.226	.212	.198
39000	13500	99.0	.429	.413	.398	.383	.368	.352	.337	.322	.307	.292	.276	.261	.246	.231	.215
41000	13500	99.0	.469	.452	.435	.418	.401	.384	.368	.351	.334	.317	.300	.284	.267	.250	.233
43000	13500	99.0	.512	.494	.475	.456	.438	.419	.400	.382	.363	.344	.326	.307	.289	.270	.251
45000	13500	99.0	.557	.536	.516	.495	.474	.453	.433	.412	.391	.371	.350	.329	.309	.288	.267

Figure 7-9. Specific Range Vs Cruise Wind - Maximum Cruise thrust

SPECIFIC RANGE VS CRUISE WIND
NORMAL CRUISE THRUST
STANDARD DAY

SPECIFIC RANGE - NAUTICAL MILES PER POUND OF FUEL																	
			TAILWIND - KNOTS								HEADWIND - KNOTS						
PRESS	AVERAGE		140	120	100	80	60	40	20	ZERO	20	40	60	80	100	120	140
ALT FEET	CRUISE WT-LBS	N1 %RPM	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE	SPEC. RANGE
23000	13500	92.0	.298	.287	.275	.264	.253	.242	.230	.219	.208	.197	.186	.174	.163	.152	.141
27000	13500	92.0	.336	.324	.311	.298	.286	.273	.260	.248	.235	.222	.210	.197	.184	.171	.159
31000	13500	92.0	.380	.366	.352	.337	.323	.309	.294	.280	.266	.251	.237	.222	.208	.194	.179
33000	13500	92.0	.403	.388	.373	.358	.342	.327	.312	.297	.282	.266	.251	.236	.221	.205	.190
35000	13500	92.0	.429	.413	.397	.381	.364	.348	.332	.316	.299	.283	.267	.251	.234	.218	.202
37000	13500	92.0	.463	.445	.428	.410	.392	.375	.357	.340	.322	.304	.287	.269	.251	.234	.216
39000	13500	92.0	.505	.486	.466	.447	.427	.408	.388	.369	.349	.330	.310	.291	.271	.252	.232
41000	13500	92.0	.550	.528	.506	.485	.463	.442	.420	.398	.377	.355	.334	.312	.290	.269	.247

Figure 7-10. Specific Range Vs Cruise Wind - Normal Cruise Thrust

SPECIFIC RANGE VS CRUISE WIND
LONG RANGE CRUISE
STANDARD DAY

SPECIFIC RANGE - NAUTICAL MILES PER POUND OF FUEL															
		TAILWIND - KNOTS													
PRESSURE ALTITUDE FEET	AVERAGE CRUISE WEIGHT-LBS	140		120		100		80		60		40		20	
		N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE
19000	13500	69.2	.430	69.6	.405	70.1	.380	70.8	.355	71.6	.330	72.5	.306	73.6	.283
23000	13500	73.2	.456	73.3	.434	73.7	.410	74.2	.386	74.9	.360	75.6	.335	76.5	.311
27000	13500	76.1	.497	76.4	.470	76.7	.443	77.0	.417	77.3	.391	77.8	.365	78.4	.340
31000	13500	78.5	.533	78.8	.505	79.1	.478	79.4	.450	79.8	.423	80.2	.397	80.7	.371
33000	13500	80.0	.550	80.3	.522	80.6	.494	80.8	.467	81.1	.440	81.5	.413	81.9	.387
35000	13500	81.5	.569	81.6	.541	81.8	.513	82.1	.485	82.5	.457	82.8	.430	83.2	.403
37000	13500	83.5	.585	83.7	.555	83.9	.528	84.0	.501	84.1	.474	84.3	.447	84.6	.420
39000	13500	85.7	.594	86.0	.563	86.2	.534	86.4	.507	86.6	.482	86.9	.457	87.1	.432
41000	13500	87.9	.609	88.1	.581	88.2	.553	88.3	.525	88.4	.498	88.6	.471	88.8	.444
43000	13500	90.2	.617	90.2	.590	90.4	.563	90.5	.535	90.8	.507	91.1	.480	91.4	.452
45000	13500	93.0	.624	93.1	.597	93.3	.570	93.5	.543	93.7	.517	94.0	.490	94.4	.464

SPECIFIC RANGE - NAUTICAL MILES PER POUND OF FUEL																	
		HEADWIND - KNOTS															
PRESSURE ALTITUDE FEET	AVERAGE CRUISE WEIGHT-LBS	ZERO		20		40		60		80		100		120		140	
		N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE	N1 %RPM	SPEC. RANGE
19000	13500	74.9	.260	76.2	.239	77.8	.218	79.4	.198	81.2	.180	83.1	.162	85.0	.146	86.8	.132
23000	13500	77.4	.287	78.4	.264	79.5	.242	80.7	.221	82.0	.201	83.4	.183	85.0	.166	86.8	.149
27000	13500	79.1	.316	79.9	.292	80.9	.269	82.0	.246	83.2	.225	84.6	.205	85.9	.185	87.3	.167
31000	13500	81.3	.346	81.9	.321	82.7	.297	83.6	.273	84.6	.250	85.7	.228	86.9	.206	88.3	.184
33000	13500	82.5	.361	83.0	.335	83.7	.311	84.5	.286	85.4	.263	86.3	.241	87.3	.219	88.3	.199
35000	13500	83.6	.377	84.1	.351	84.6	.326	85.2	.301	85.8	.277	86.6	.254	87.6	.231	88.8	.210
37000	13500	85.0	.393	85.5	.366	86.1	.338	86.8	.311	87.5	.285	88.4	.261	89.2	.238	89.9	.219
39000	13500	87.3	.407	87.5	.381	87.8	.355	88.2	.329	88.7	.303	89.4	.278	90.3	.254	91.5	.232
41000	13500	89.0	.418	89.3	.391	89.8	.366	90.3	.340	90.9	.315	91.8	.291	92.8	.267	94.0	.245
43000	13500	91.8	.425	92.3	.398	92.8	.372	93.4	.347	94.1	.323	94.8	.300	95.6	.278	96.5	.257
45000	13500	94.7	.438	95.1	.413	95.6	.388	96.1	.363	96.7	.339	97.3	.315	98.0	.291	98.6	.268

Figure 7-11. Specific Range Vs Cruise Wind - Long Range Cruise

MAXIMUM CRUISE THRUST

CRUISE (91.1% N1)

STANDARD DAY CRUISE ALTITUDE 19000 FEET

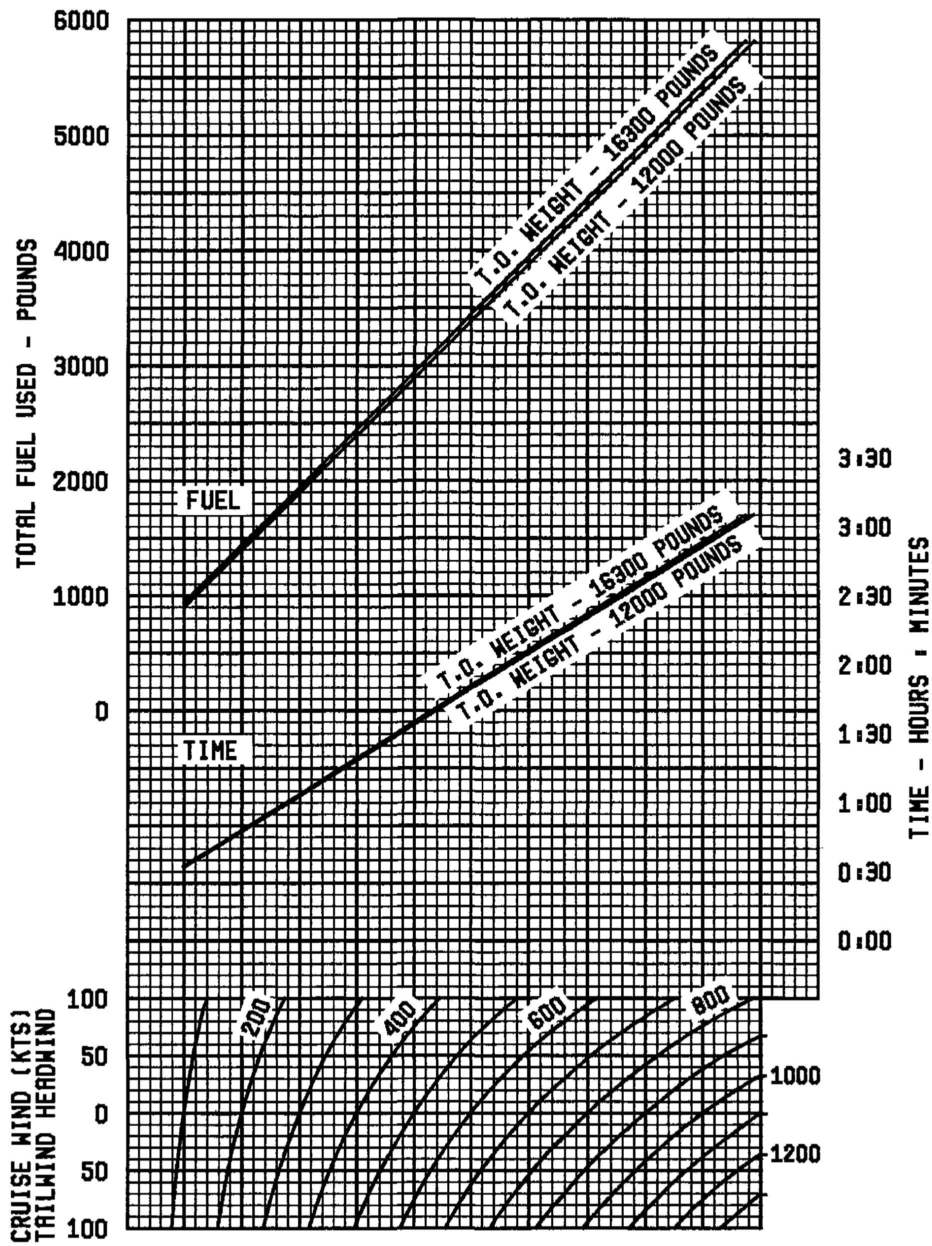


Figure 7-12. Maximum Cruise Thrust (Sheet 1 of 11)

MAXIMUM CRUISE THRUST

CRUISE (94.1% N1)

STANDARD DAY

CRUISE ALTITUDE 23000 FEET

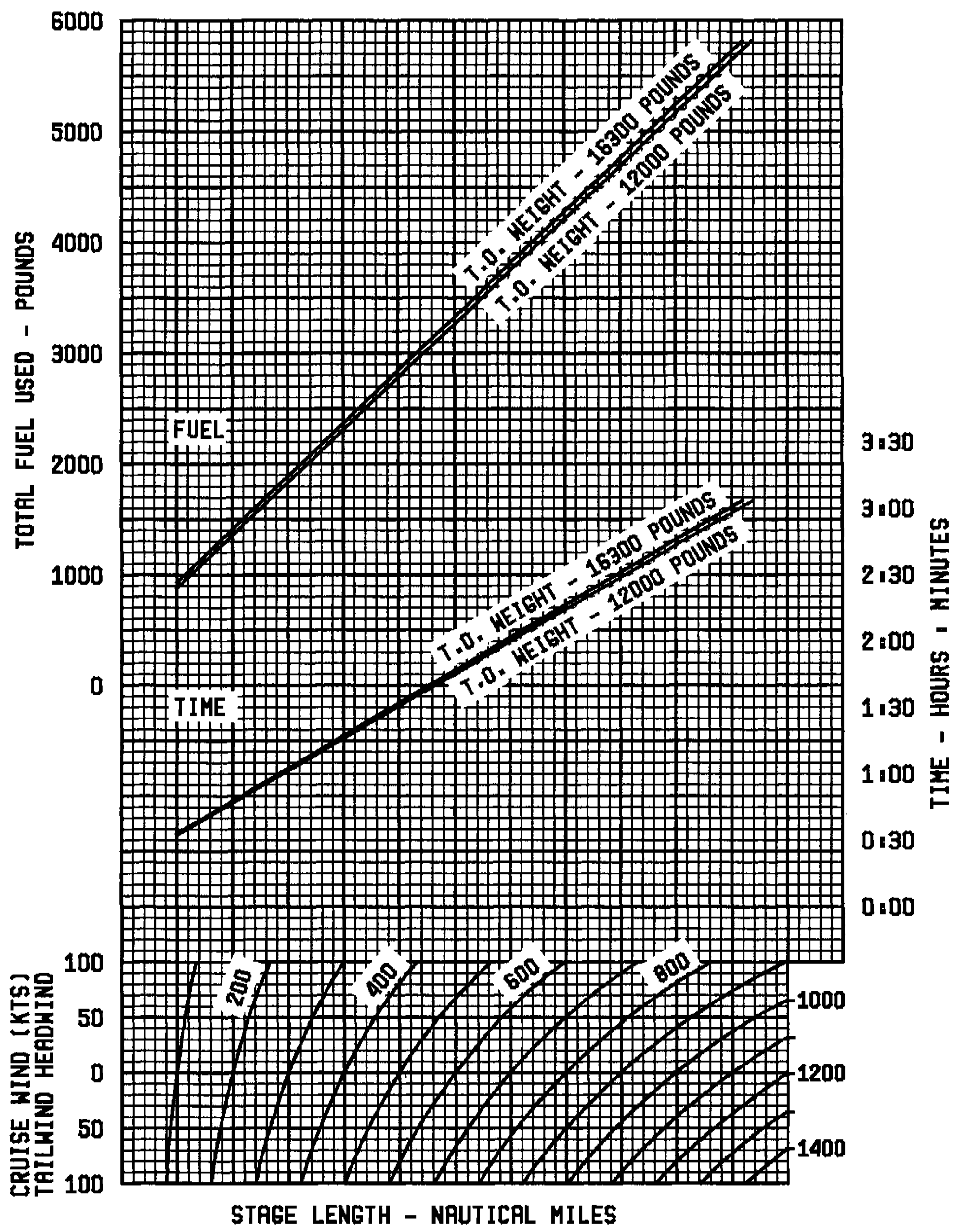


Figure 7-12. Maximum Cruise Thrust (Sheet 2 of 11)

MAXIMUM CRUISE THRUST

CRUISE (96.5% N1)

STANDARD DAY CRUISE ALTITUDE 27000 FEET

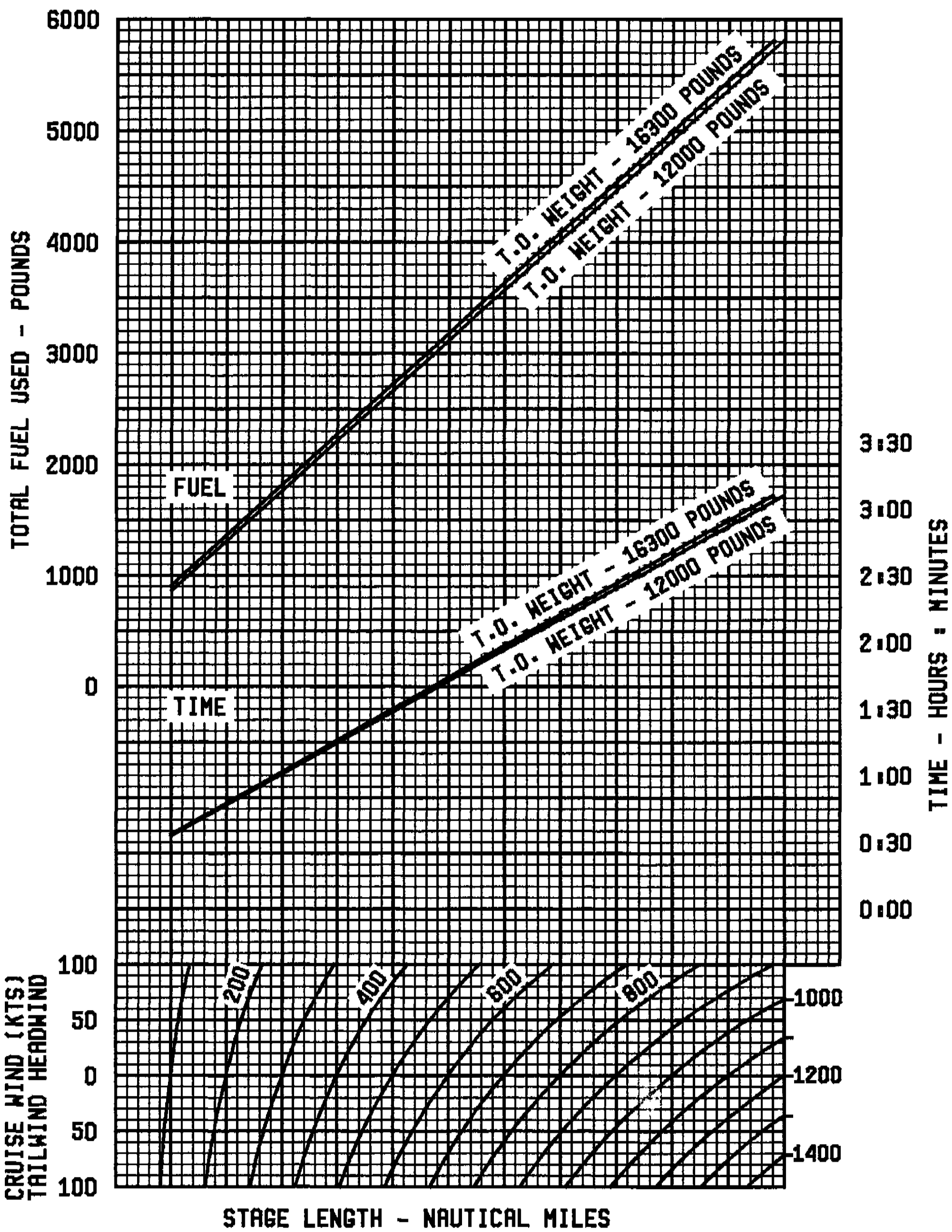


Figure 7-12. Maximum Cruise Thrust (Sheet 3 of 11)

MAXIMUM CRUISE THRUST

CRUISE (97.6% N1)

STANDARD DAY

CRUISE ALTITUDE 31000 FEET

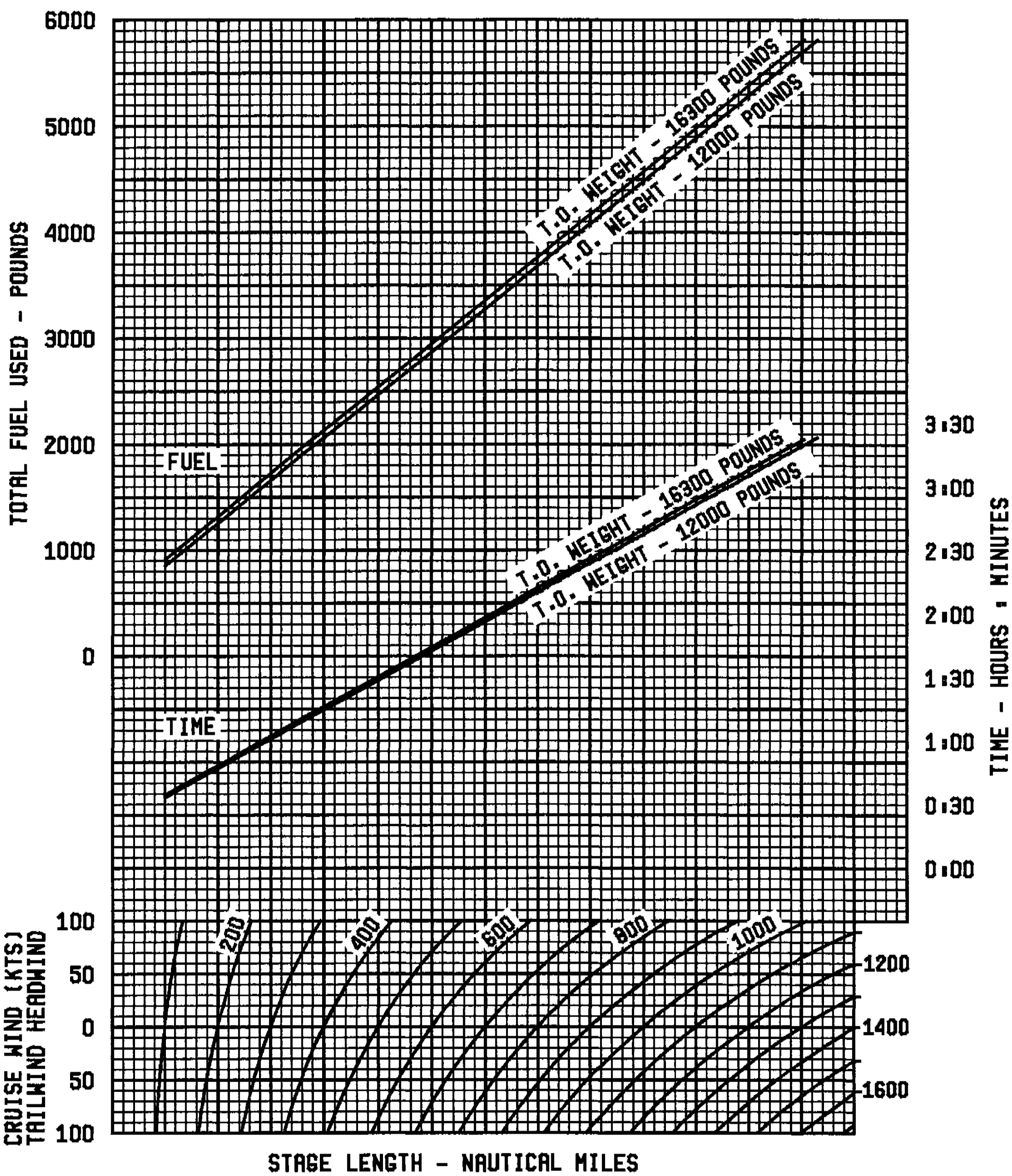


Figure 7-12. Maximum Cruise Thrust (Sheet 4 of 11)

MAXIMUM CRUISE THRUST

CRUISE (98.2% N1)

STANDARD DAY — CRUISE ALTITUDE 33000 FEET

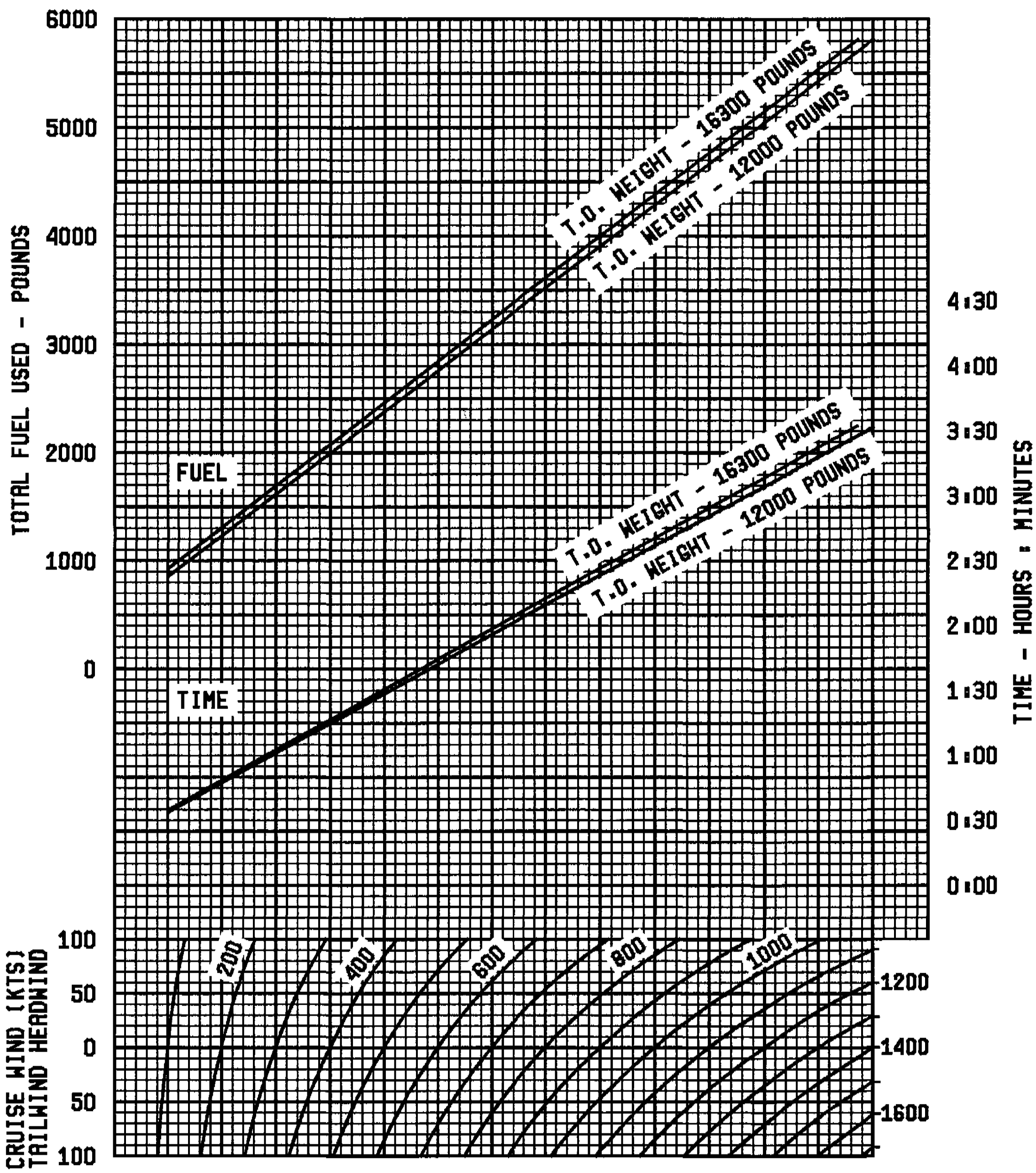


Figure 7-12. Maximum Cruise Thrust (Sheet 5 of 11)

MAXIMUM CRUISE THRUST

CRUISE (90.0% N1)

STANDARD DAY CRUISE ALTITUDE 35000 FEET

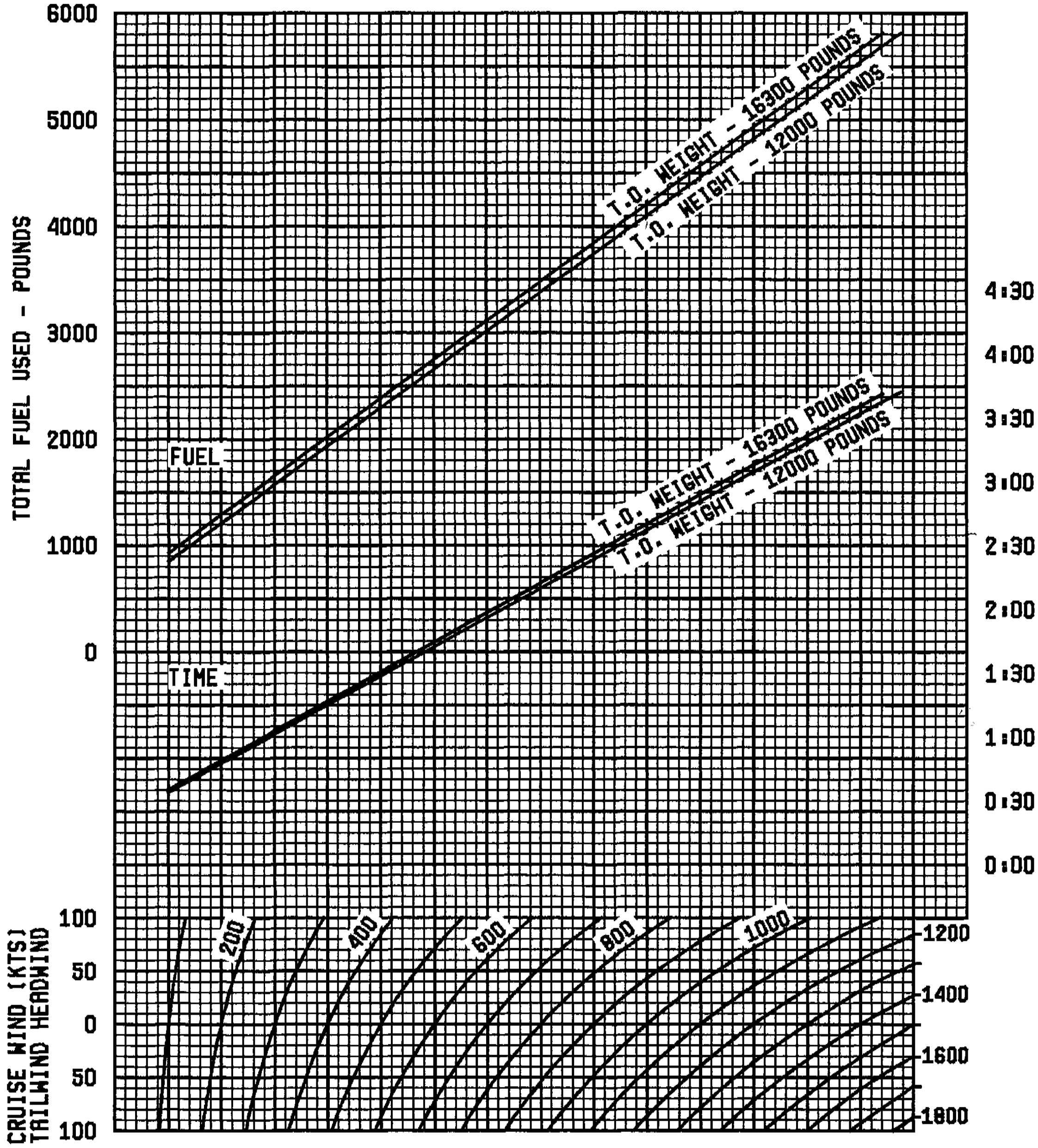


Figure 7-12. Maximum Cruise Thrust (Sheet 6 of 11)

MAXIMUM CRUISE THRUST

CRUISE (99.0% N1)

STANDARD DAY

CRUISE ALTITUDE 37000 FEET

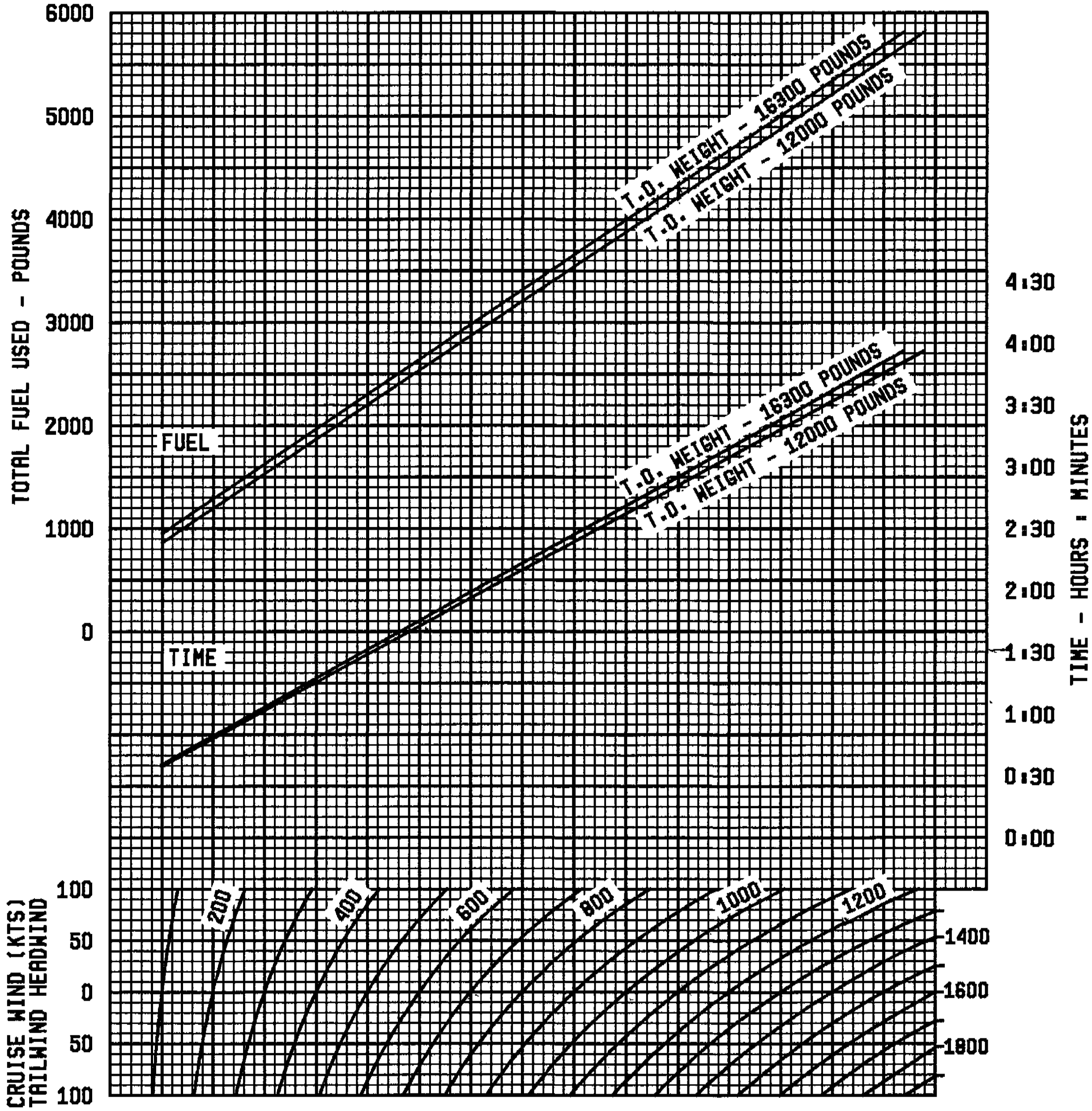


Figure 7-12. Maximum Cruise Thrust (Sheet 7 of 11)

MAXIMUM CRUISE THRUST
CRUISE (99.0% N1)

STANDARD DAY

CRUISE ALTITUDE 39000 FEET

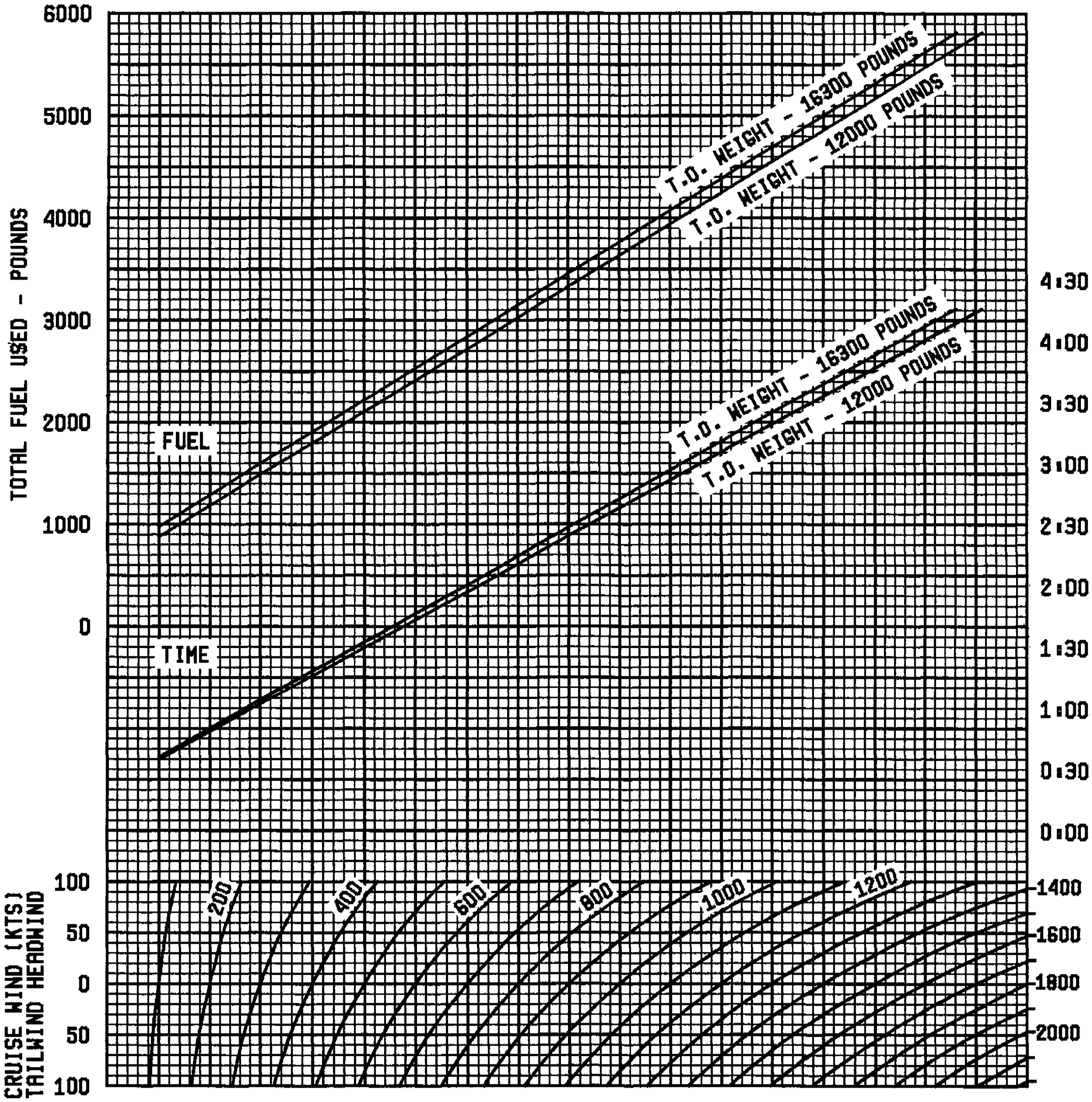


Figure 7-12. Maximum Cruise Thrust (Sheet 8 of 11)

MAXIMUM CRUISE THRUST

CRUISE (99.0% N1)

STANDARD DAY

CRUISE ALTITUDE 41000 FEET

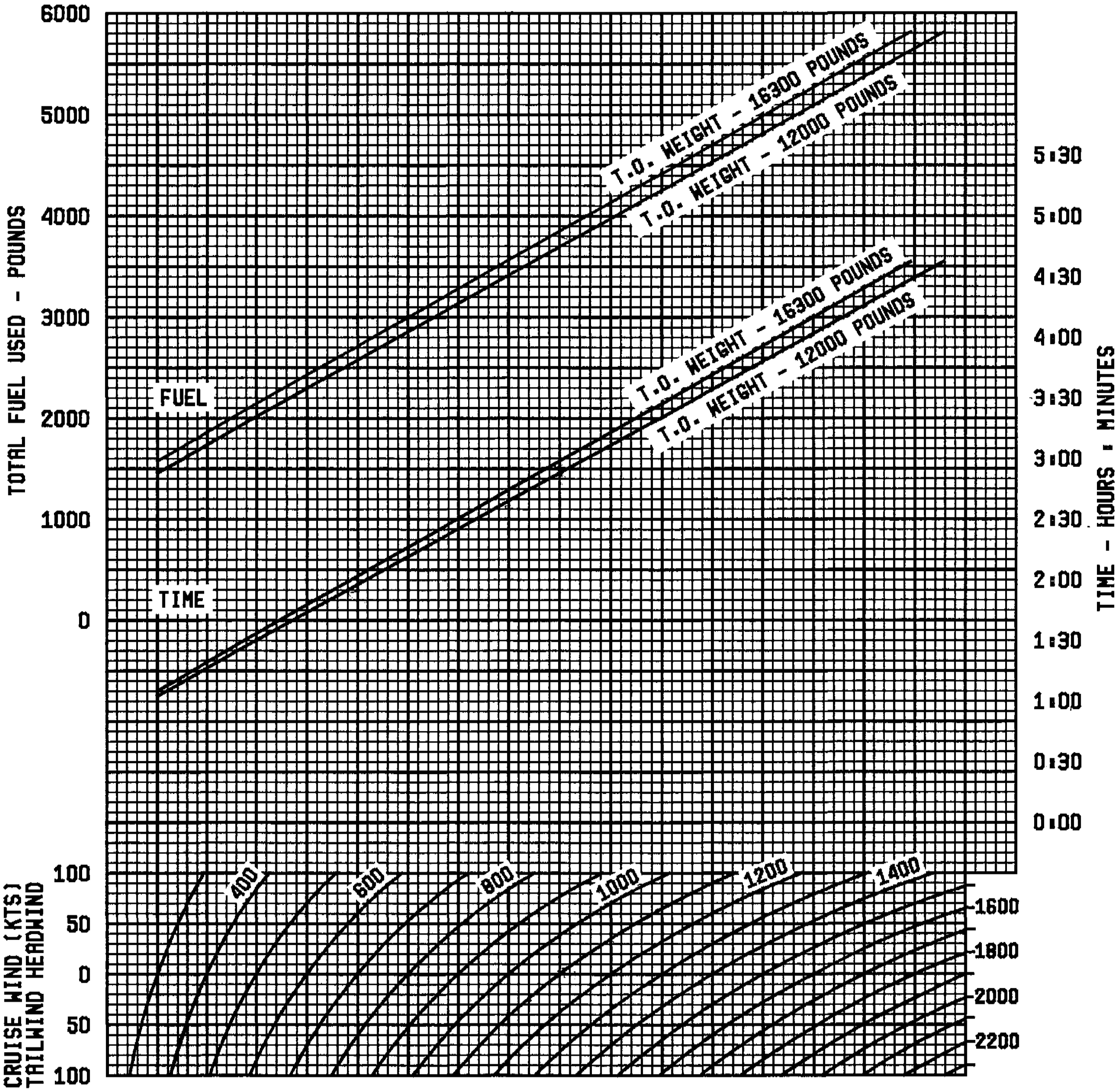


Figure 7-12. Maximum Cruise Thrust (Sheet 9 of 11)

MAXIMUM CRUISE THRUST

CRUISE (99.0% N1)

STANDARD DAY

CRUISE ALTITUDE 43000 FEET

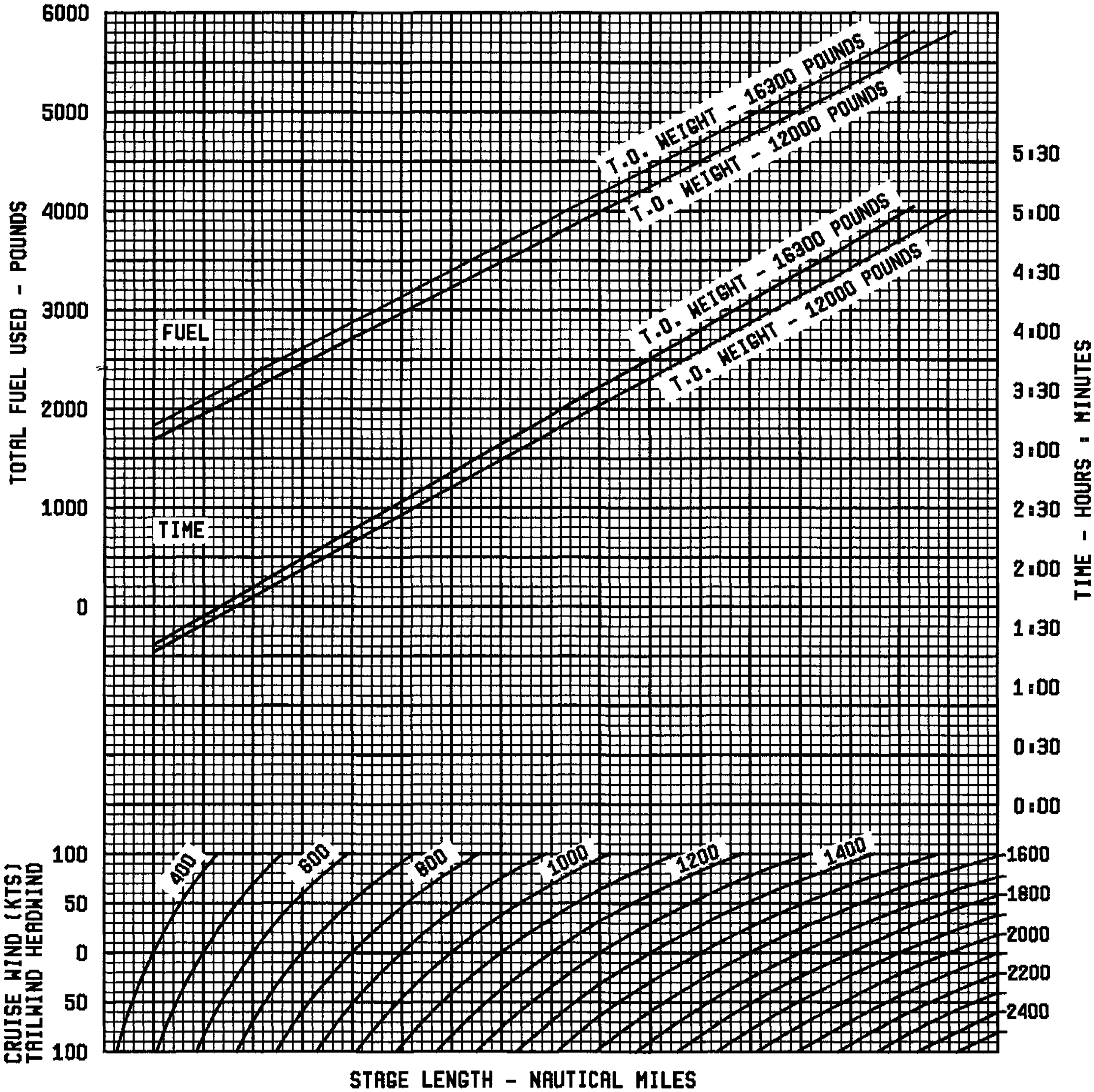


Figure 7-12. Maximum Cruise Thrust (Sheet 10 of 11)

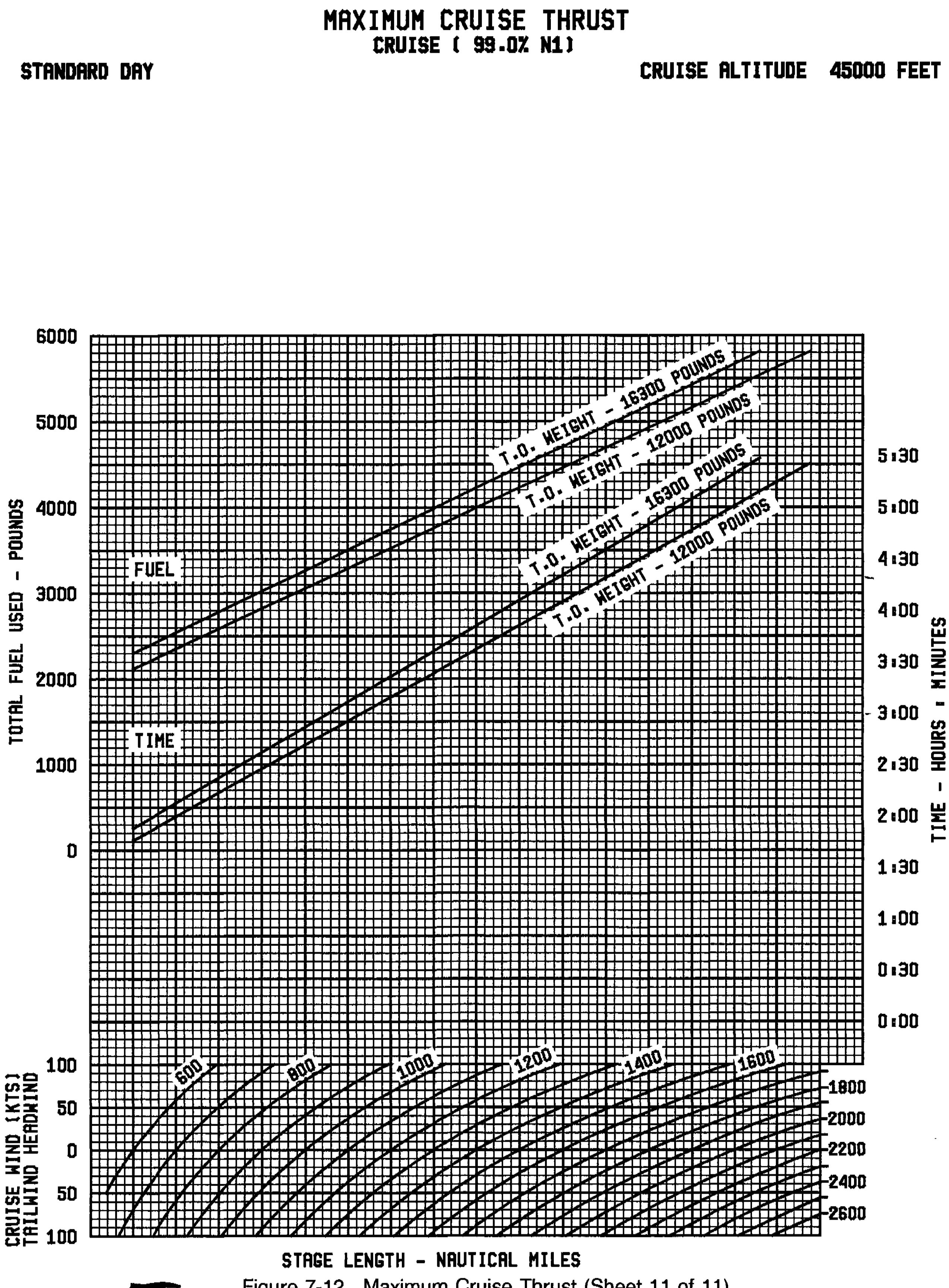


Figure 7-12. Maximum Cruise Thrust (Sheet 11 of 11)

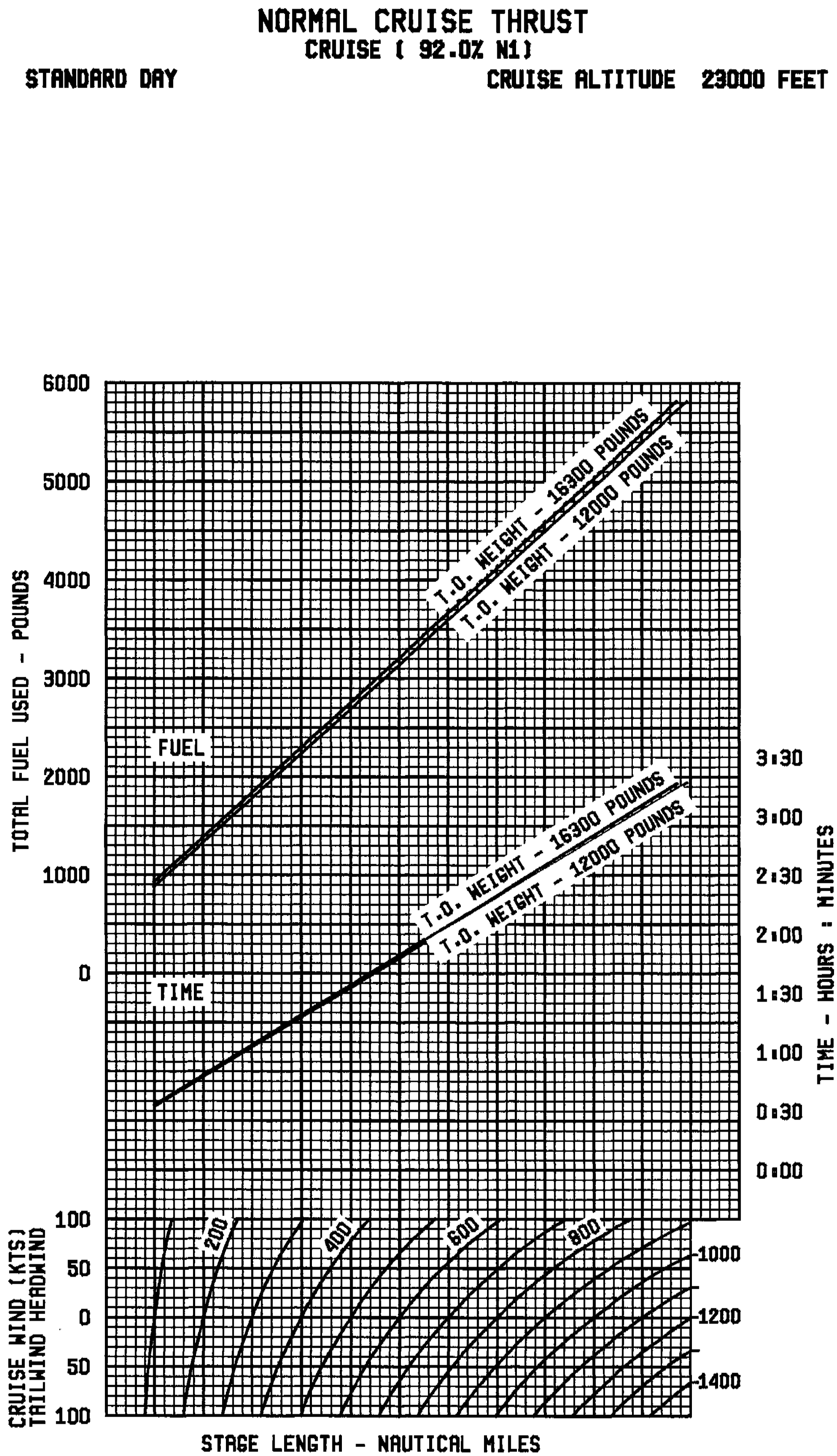


Figure 7-13. Normal Cruise Thrust (Sheet 1 of 8)

NORMAL CRUISE THRUST
CRUISE (92.0% N1)

STANDARD DAY — CRUISE ALTITUDE 27000 FEET

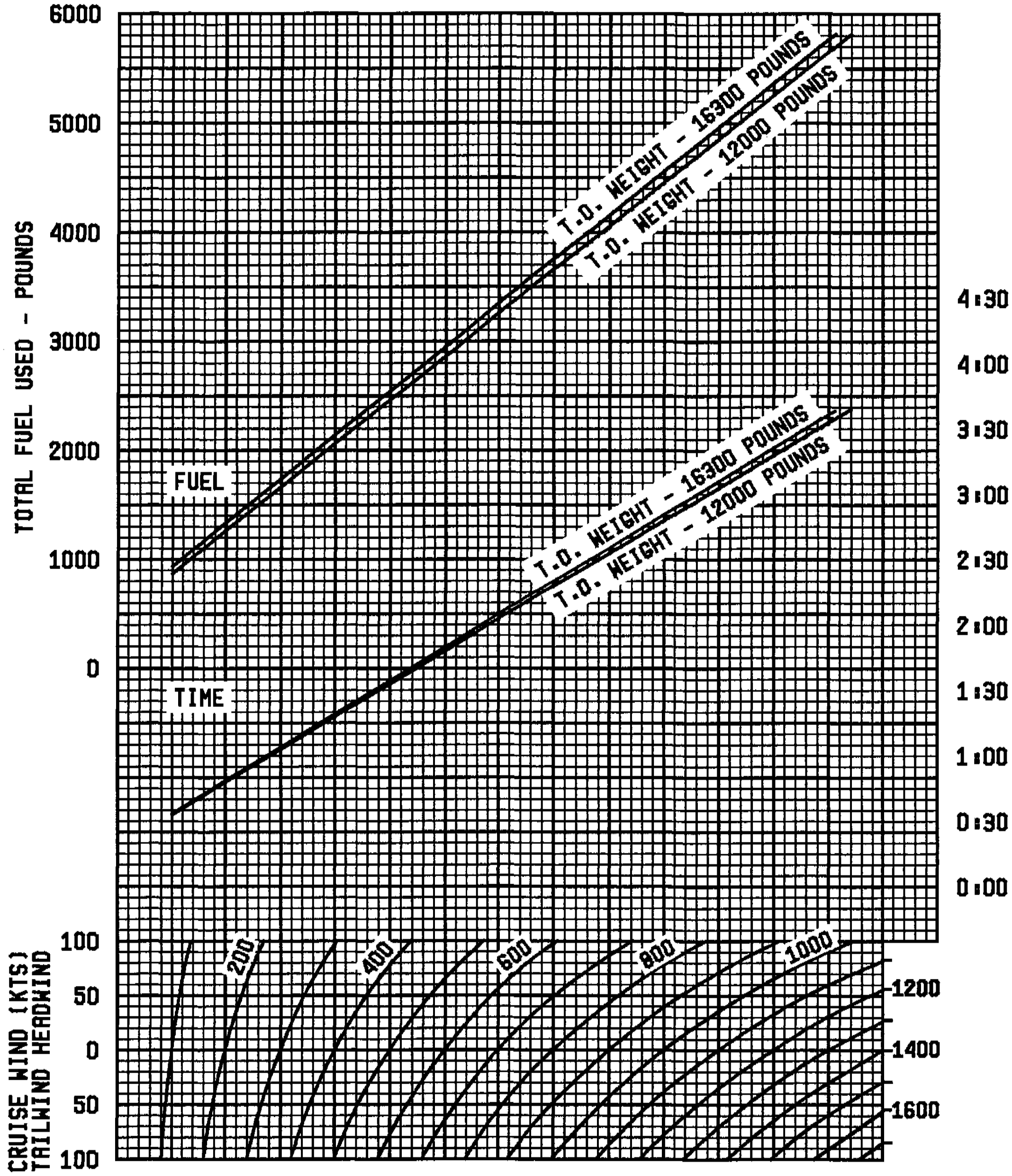


Figure 7-13. Normal Cruise Thrust (Sheet 2 of 8)

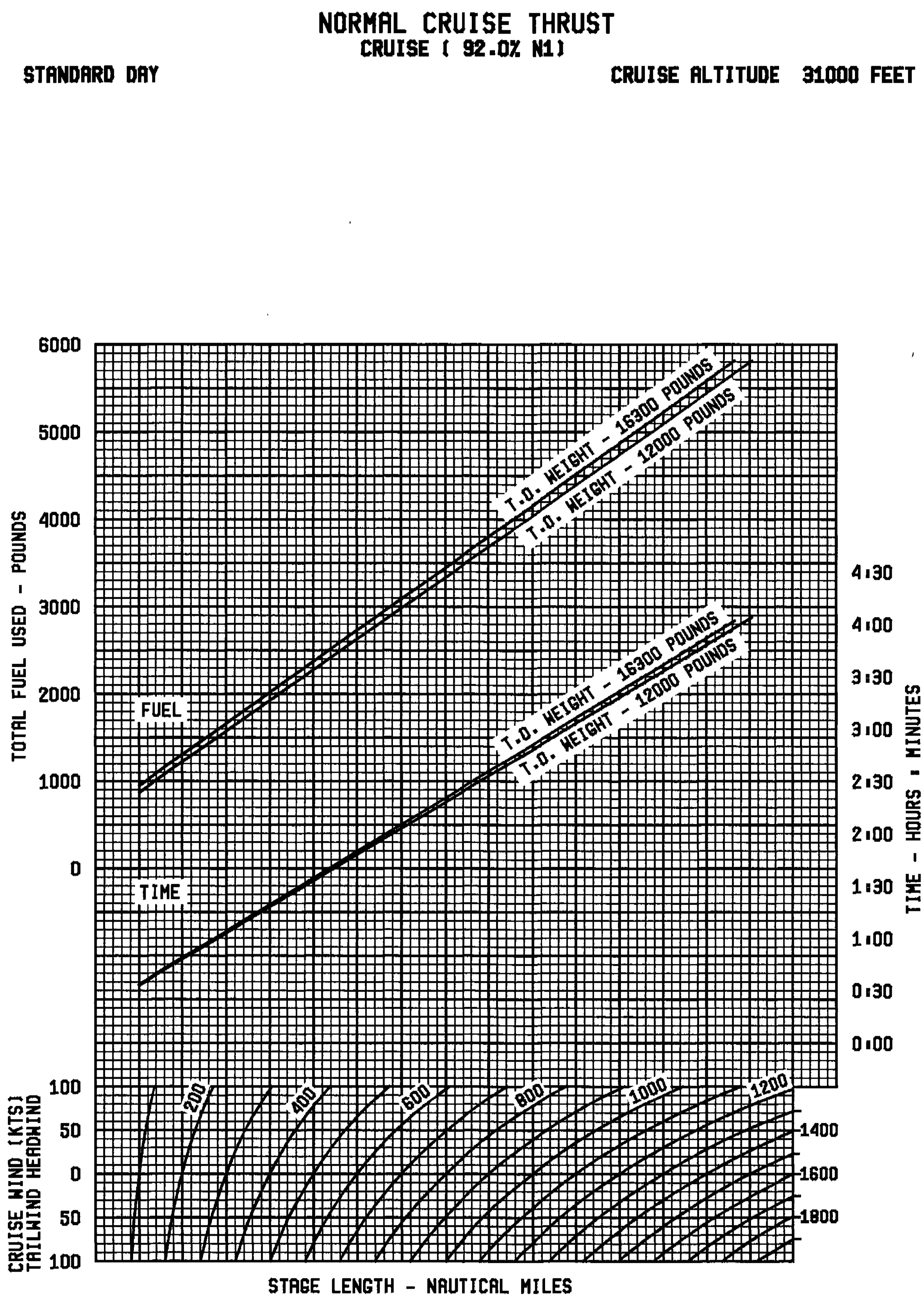


Figure 7-13. Normal Cruise Thrust (Sheet 3 of 8)

NORMAL CRUISE THRUST

CRUISE (92.0% N1)

STANDARD DAY — CRUISE ALTITUDE 33000 FEET

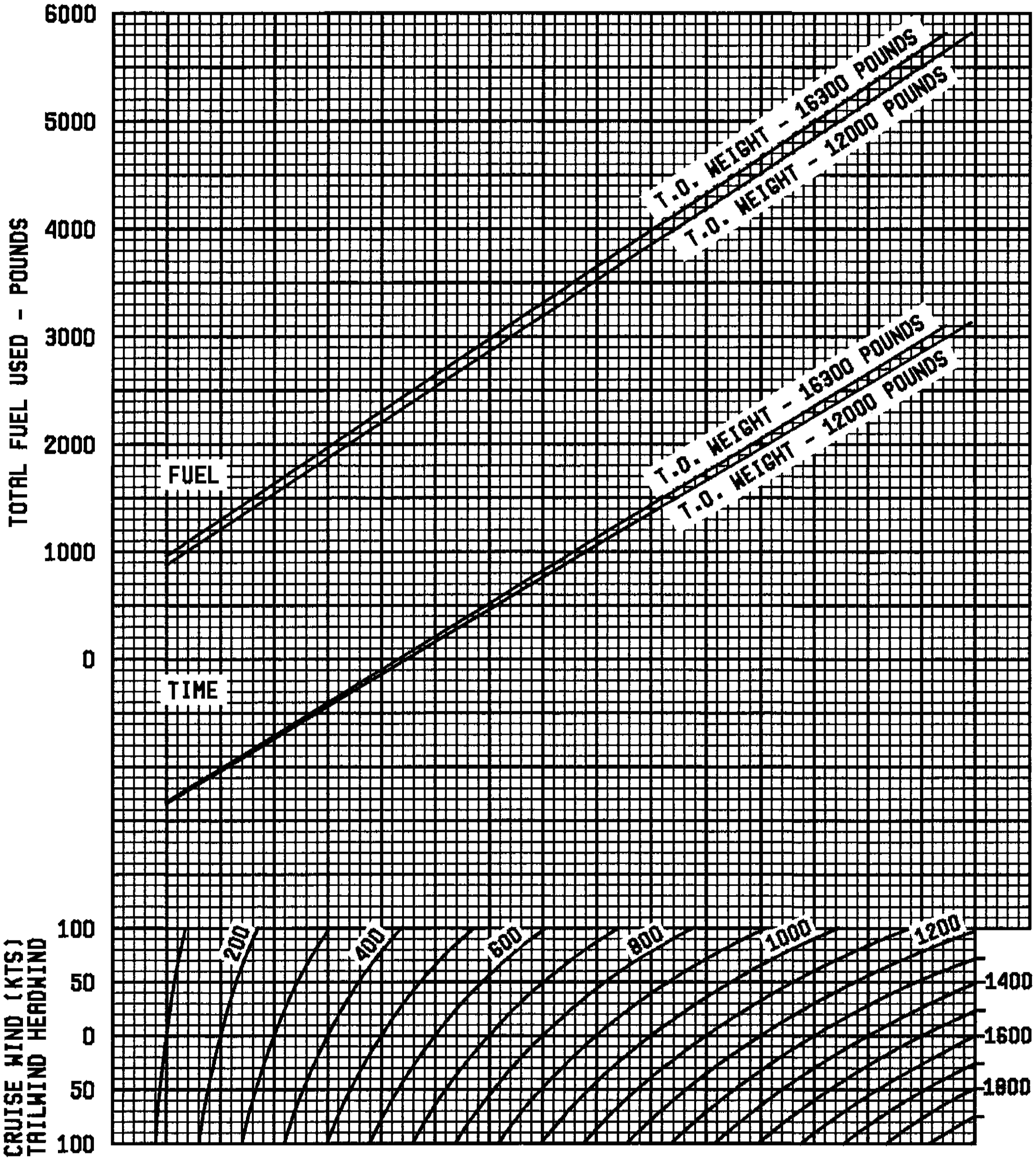


Figure 7-13. Normal Cruise Thrust (Sheet 4 of 8)

NORMAL CRUISE THRUST

CRUISE (92.0% N1)

STANDARD DAY

CRUISE ALTITUDE 35000 FEET

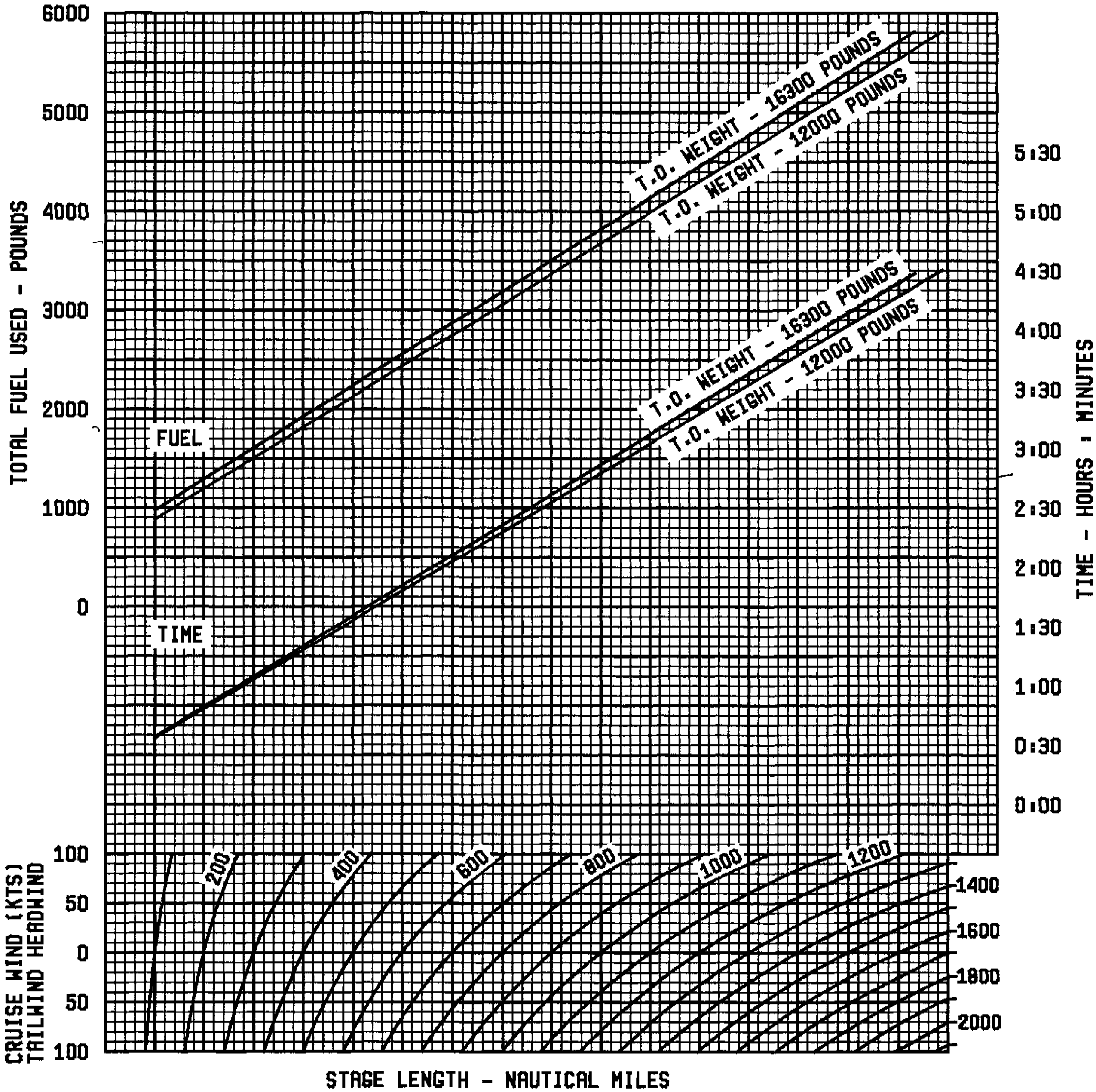


Figure 7-13. Normal Cruise Thrust (Sheet 5 of 8)

NORMAL CRUISE THRUST

CRUISE (92.0% N1)

STANDARD DAY

CRUISE ALTITUDE 37000 FEET

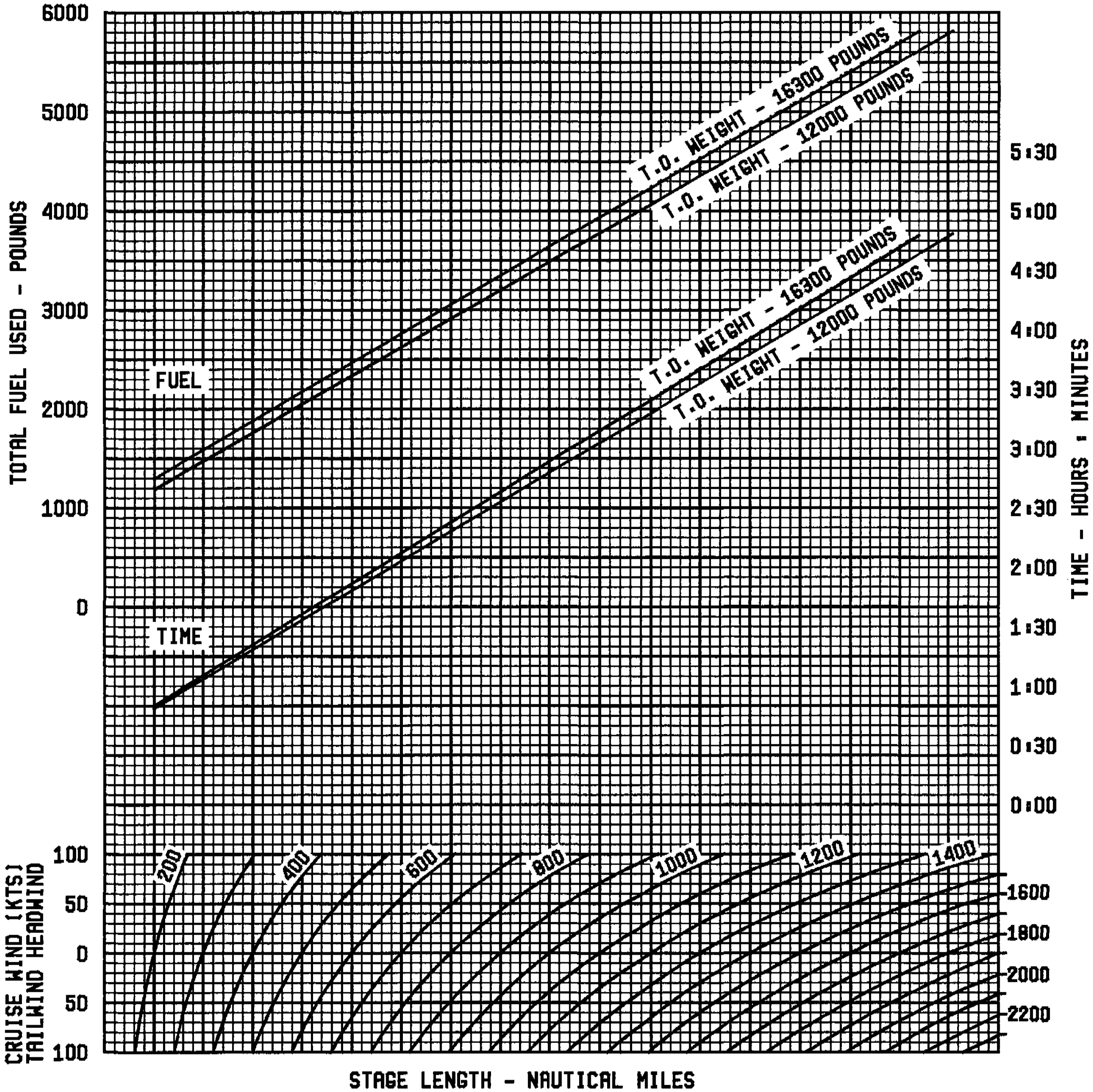


Figure 7-13. Normal Cruise Thrust (Sheet 6 of 8)

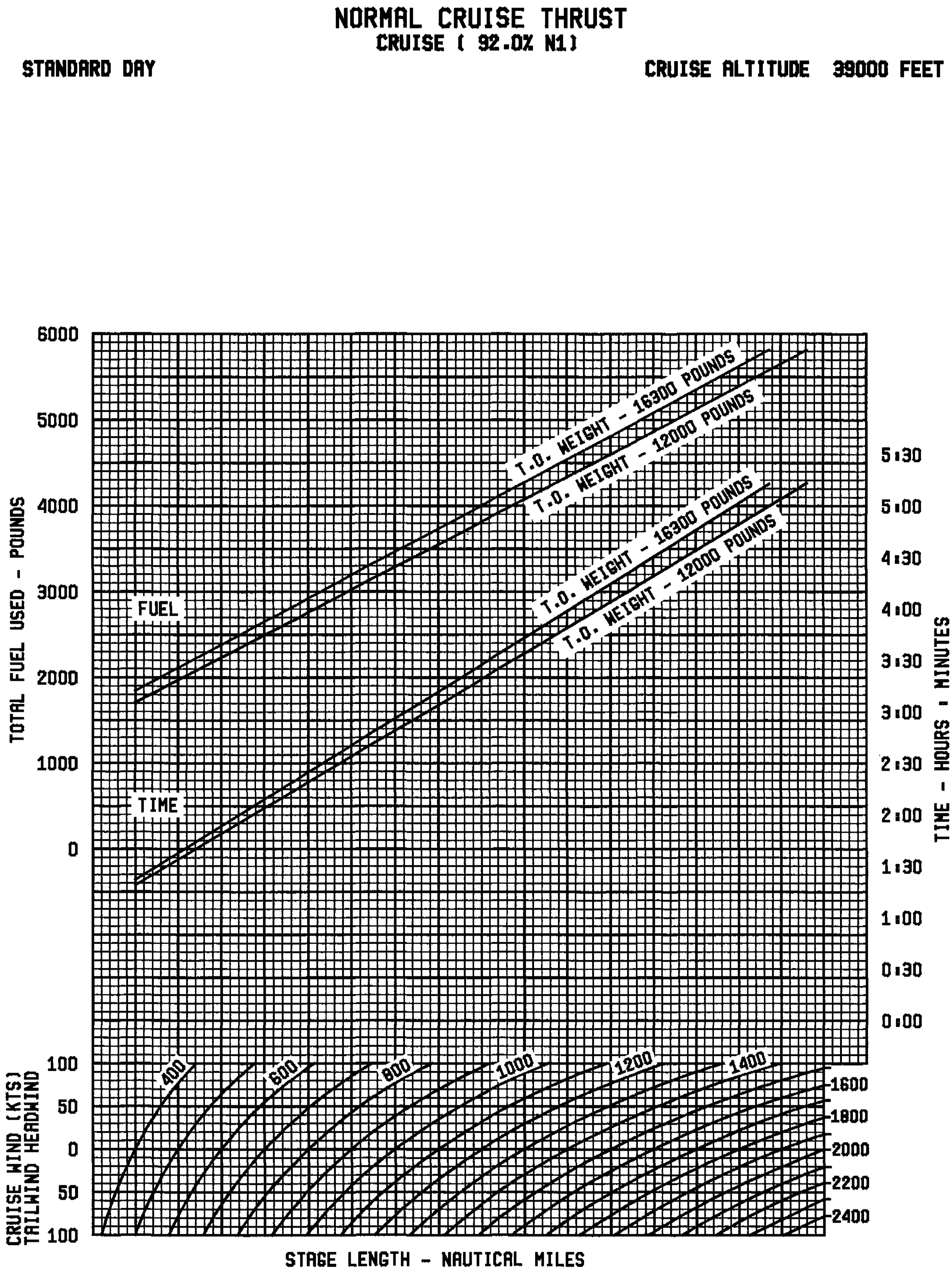


Figure 7-13. Normal Cruise Thrust (Sheet 7 of 8)

NORMAL CRUISE THRUST

CRUISE (92.0% N1)

STANDARD DAY

CRUISE ALTITUDE 41000 FEET

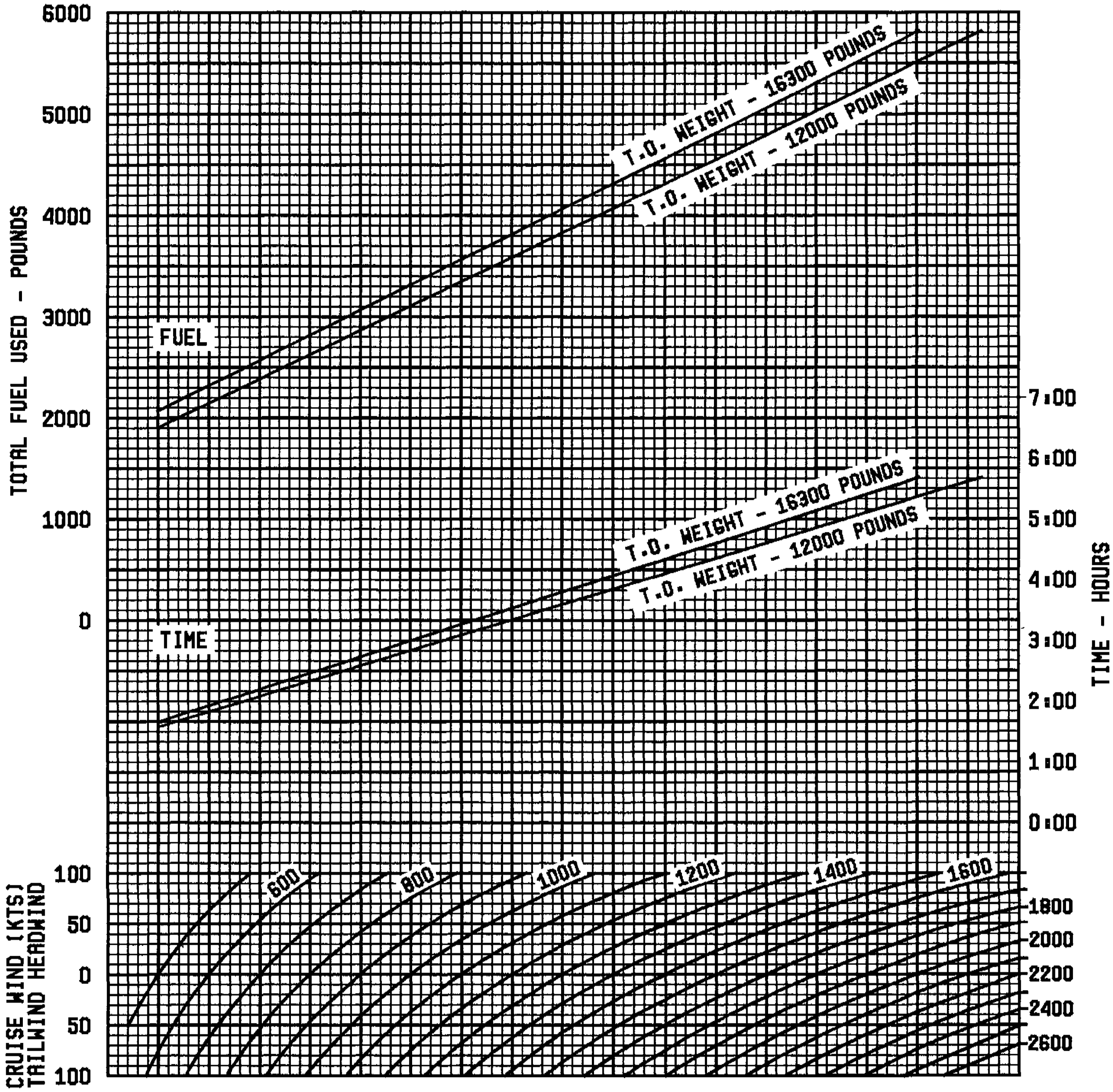


Figure 7-13. Normal Cruise Thrust (Sheet 8 of 8)

LONG RANGE CRUISE

STANDARD DAY **CRUISE ALTITUDE 19000 FEET**

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS. 16000	15000	14000	13000	12000
TAILWIND	100	74.8	73.1	71.3	69.1	66.9
	50	76.5	74.6	72.9	70.9	69.8
	0	78.8	77.4	75.6	73.9	72.1
HEADWIND	50	81.2	80.3	79.5	78.7	78.3
	100	84.7	84.0	83.2	82.4	81.6

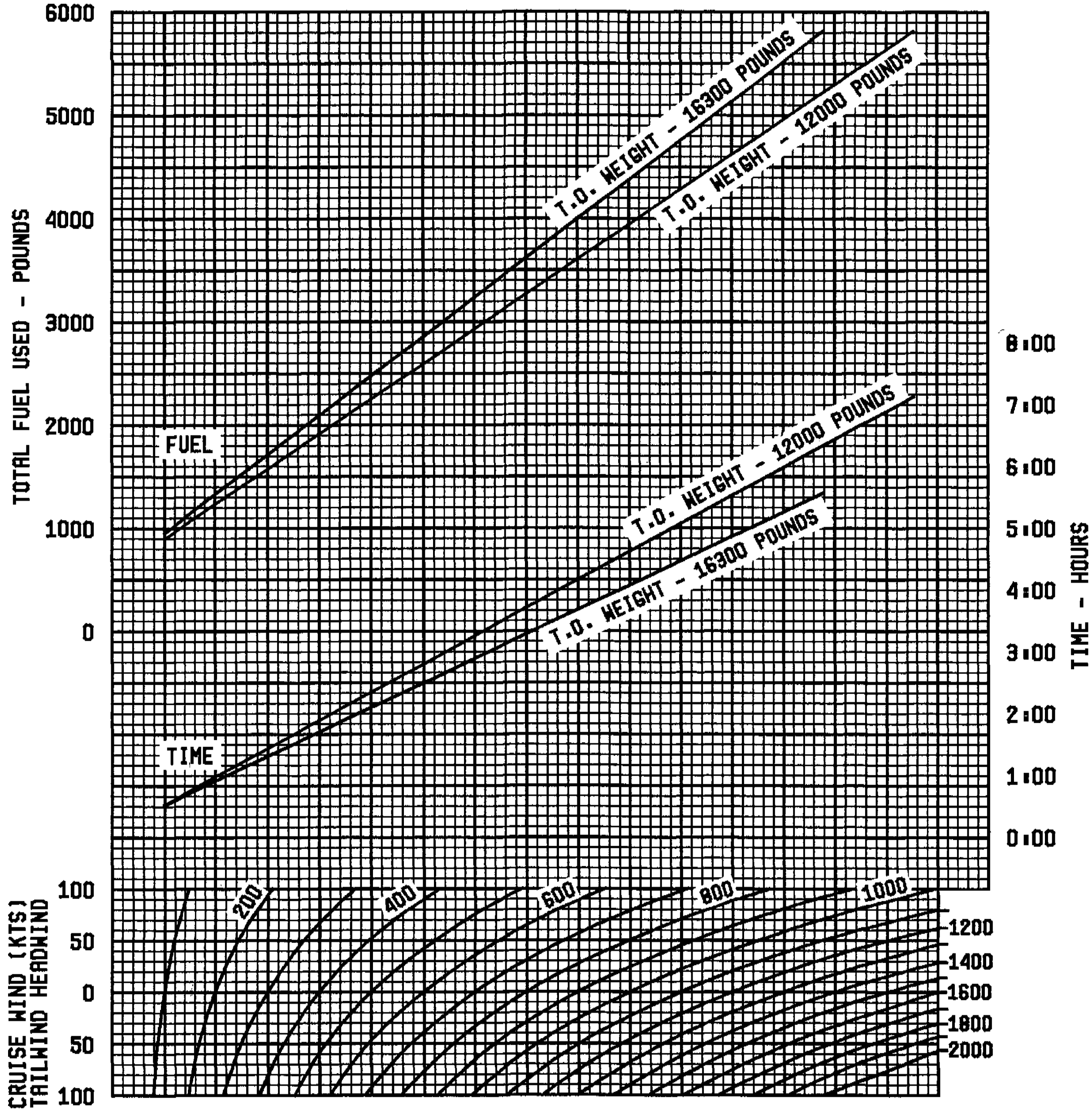


Figure 7-14 Long Range Cruise (Sheet 1 of 11)

LONG RANGE CRUISE

STANDARD DAY **CRUISE ALTITUDE 23000 FEET**

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS. 16000	15000	14000	13000	12000
TAILWIND	100	77.8	76.6	74.7	72.5	71.2
	50	78.9	77.6	76.3	74.1	72.0
	0	81.1	79.2	78.0	76.9	74.9
HEADWIND	50	82.5	81.5	80.5	79.4	78.4
	100	86.0	85.0	83.9	83.1	82.9

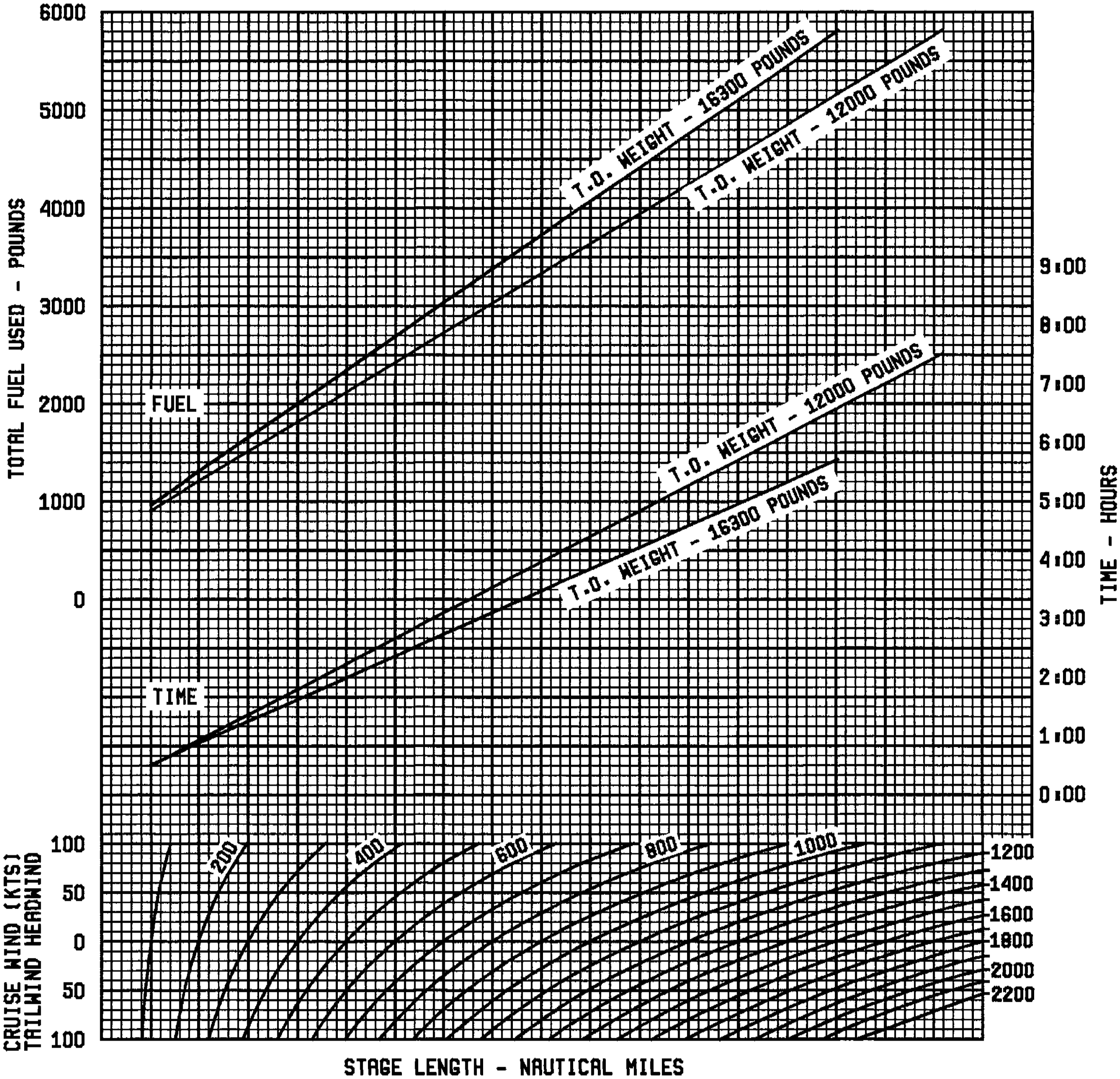


Figure 7-14 Long Range Cruise (Sheet 2 of 11)

LONG RANGE CRUISE

STANDARD DAY **CRUISE ALTITUDE 27000 FEET**

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS. 16000	15000	14000	13000	12000
TAILWIND	100	80.1	78.9	77.4	75.8	74.0
	50	81.1	79.8	78.4	76.9	75.5
	0	82.4	81.1	79.9	78.5	77.0
HEADWIND	50	84.2	83.7	81.8	80.7	80.3
	100	86.8	85.9	85.2	84.3	83.0

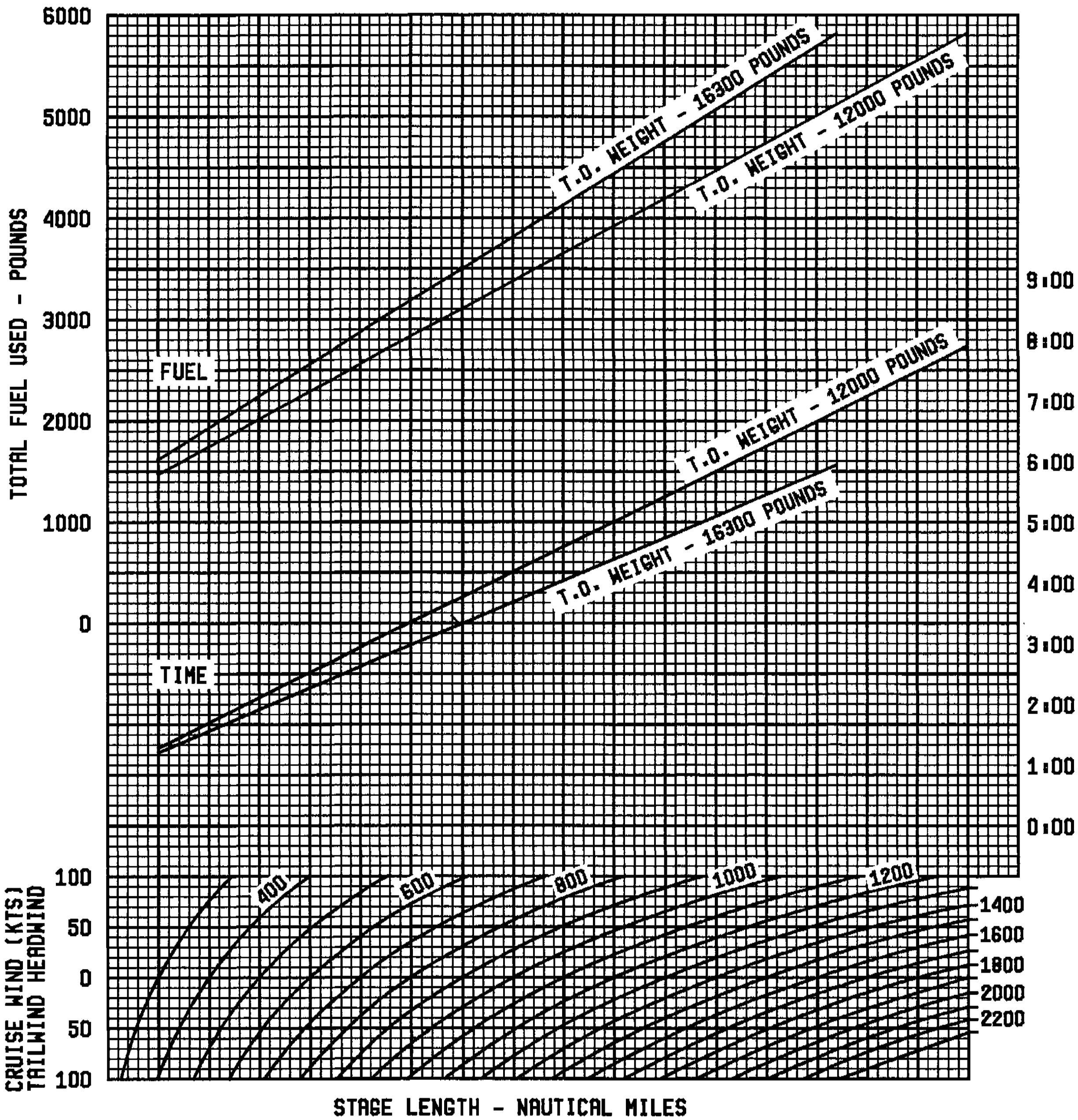


Figure 7-14 Long Range Cruise (Sheet 3 of 11)

LONG RANGE CRUISE

STANDARD DAY

CRUISE ALTITUDE 31000 FEET

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS. 16000	15000	14000	13000	12000
TAILWIND	100	82.9	81.5	79.9	78.3	76.6
	50	83.6	82.3	80.8	79.1	77.6
	0	84.5	83.3	81.9	80.5	78.9
HEADWIND	50	86.4	85.1	83.7	82.5	81.0
	100	87.9	87.1	86.3	85.1	84.1

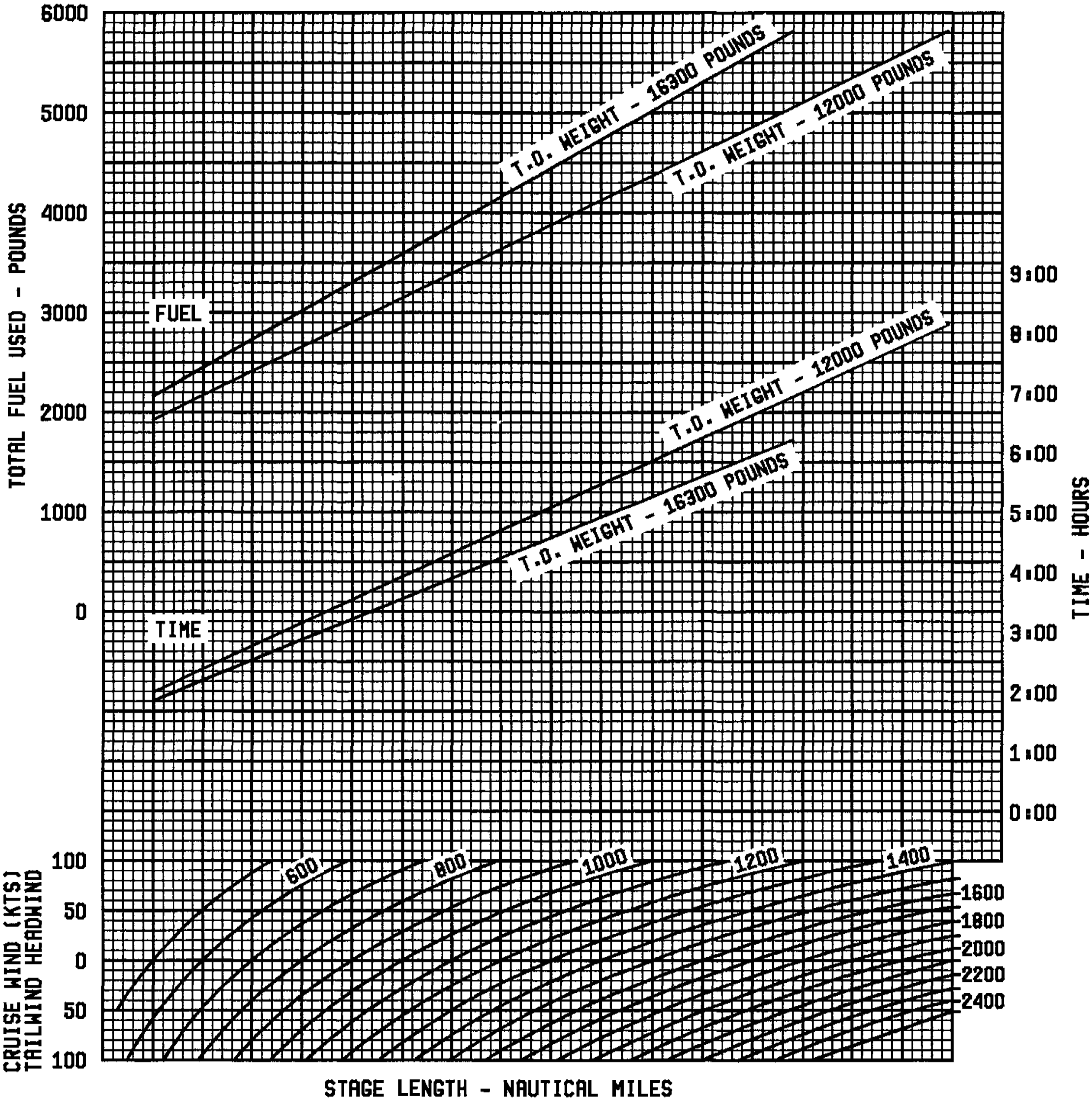


Figure 7-14 Long Range Cruise (Sheet 4 of 11)

LONG RANGE CRUISE

STANDARD DAY **CRUISE ALTITUDE 33000 FEET**

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS. 16000	15000	14000	13000	12000
TAILWIND	100	84.4	82.9	81.4	79.6	77.7
	50	85.2	83.6	82.1	80.5	78.7
	0	86.0	84.7	83.2	81.7	80.0
HEADWIND	50	87.1	86.1	84.9	83.3	82.1
	100	88.7	87.6	87.2	85.9	84.6

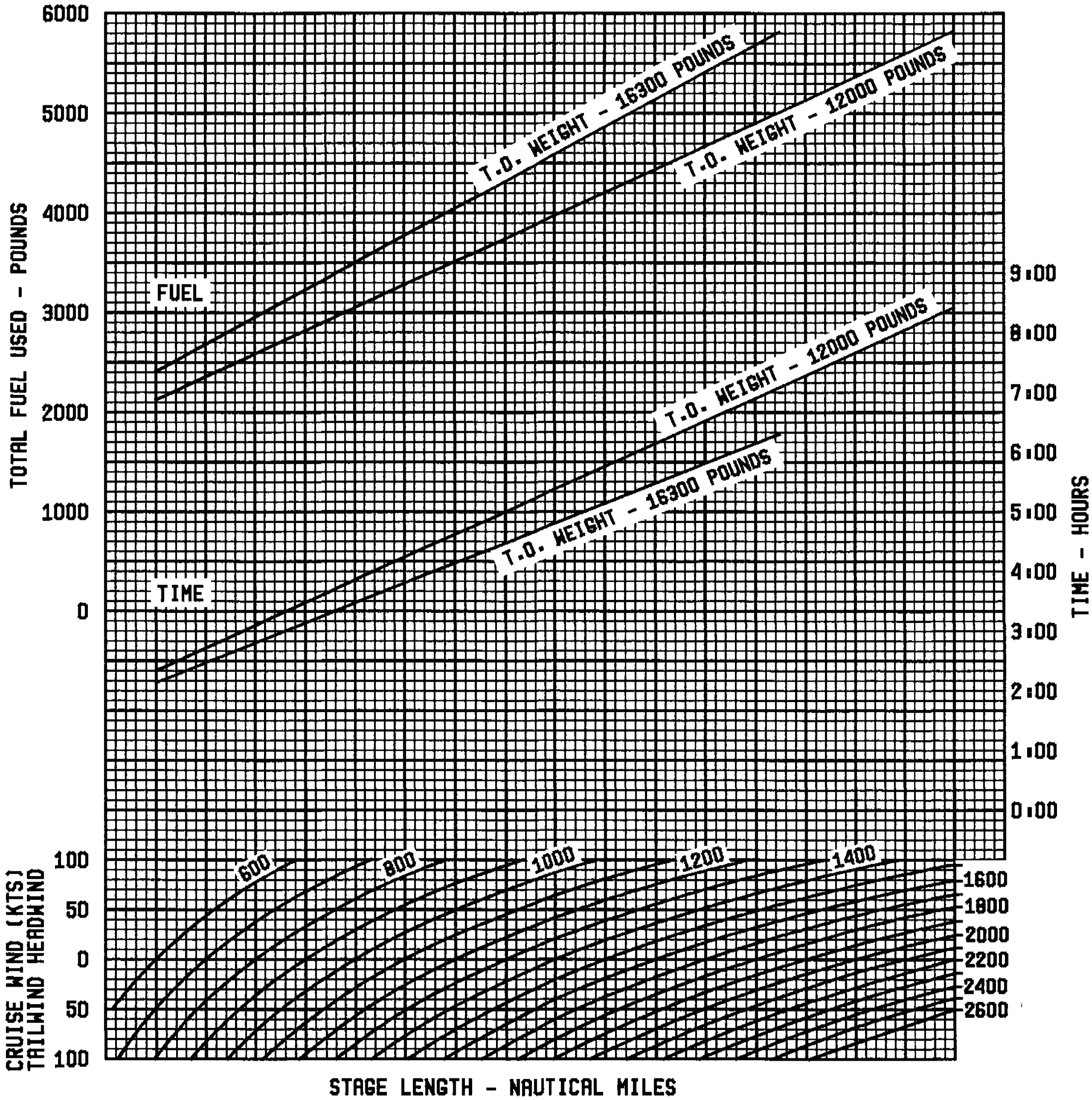


Figure 7-14 Long Range Cruise (Sheet 5 of 11)

LONG RANGE CRUISE

STANDARD DAY **CRUISE ALTITUDE 35000 FEET**

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS. 16000	15000	14000	13000	12000
TAILWIND	100	85.8	84.4	82.7	81.0	79.3
	50	86.4	85.3	83.4	81.7	80.1
	0	87.2	85.7	84.9	82.8	81.2
HEADWIND	50	88.2	87.4	85.6	84.5	82.9
	100	89.5	88.5	87.2	86.0	85.0

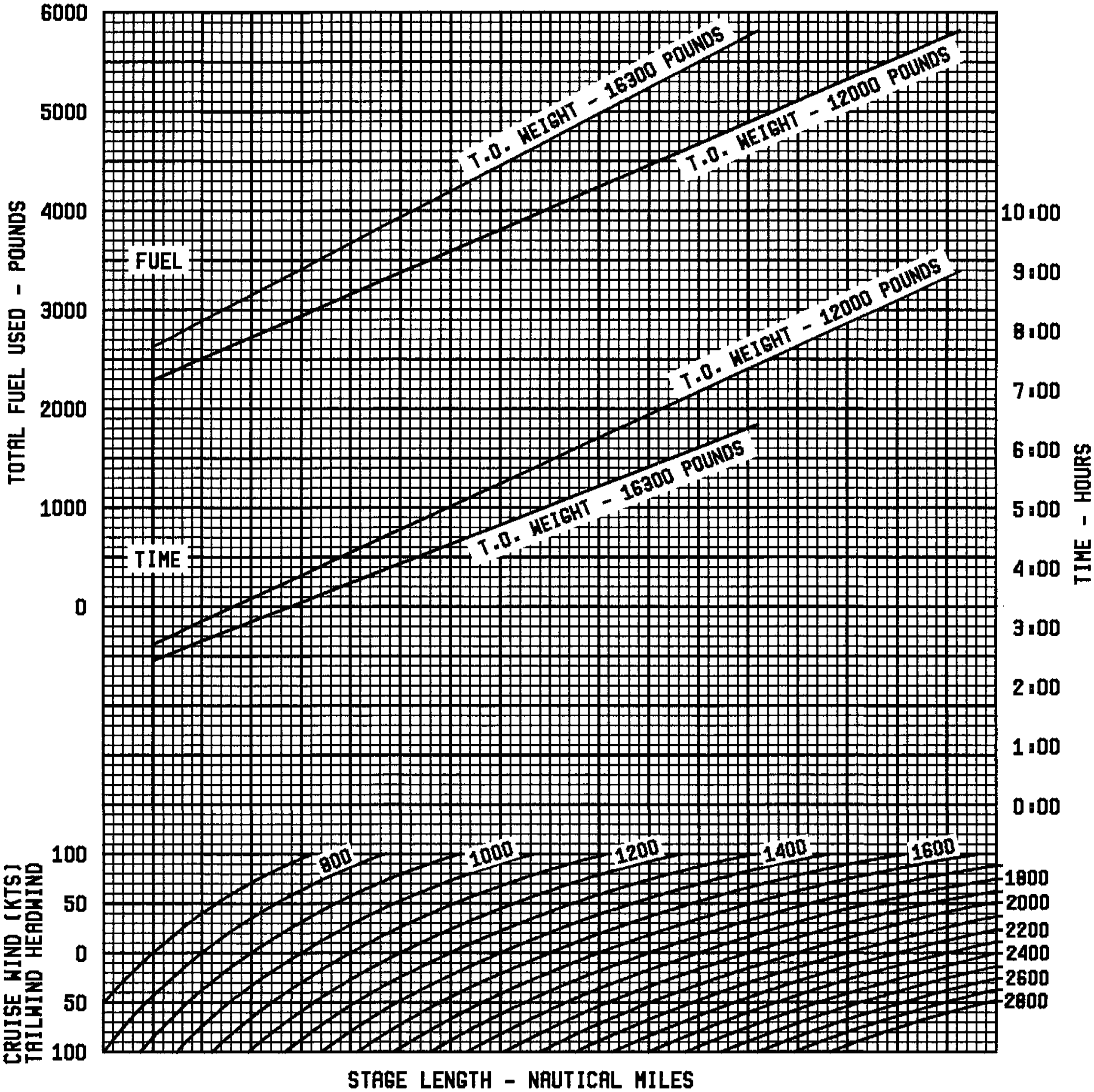


Figure 7-14 Long Range Cruise (Sheet 6 of 11)

LONG RANGE CRUISE

STANDARD DAY **CRUISE ALTITUDE 37000 FEET**

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS.				
		16000	15000	14000	13000	12000
TAILWIND	100	87.8	86.2	84.5	82.9	81.0
	50	88.1	86.8	85.4	83.5	81.7
	0	88.6	87.5	86.0	84.4	82.8
HEADWIND	50	90.0	88.7	87.1	85.4	84.3
	100	90.9	89.5	88.5	87.8	86.0

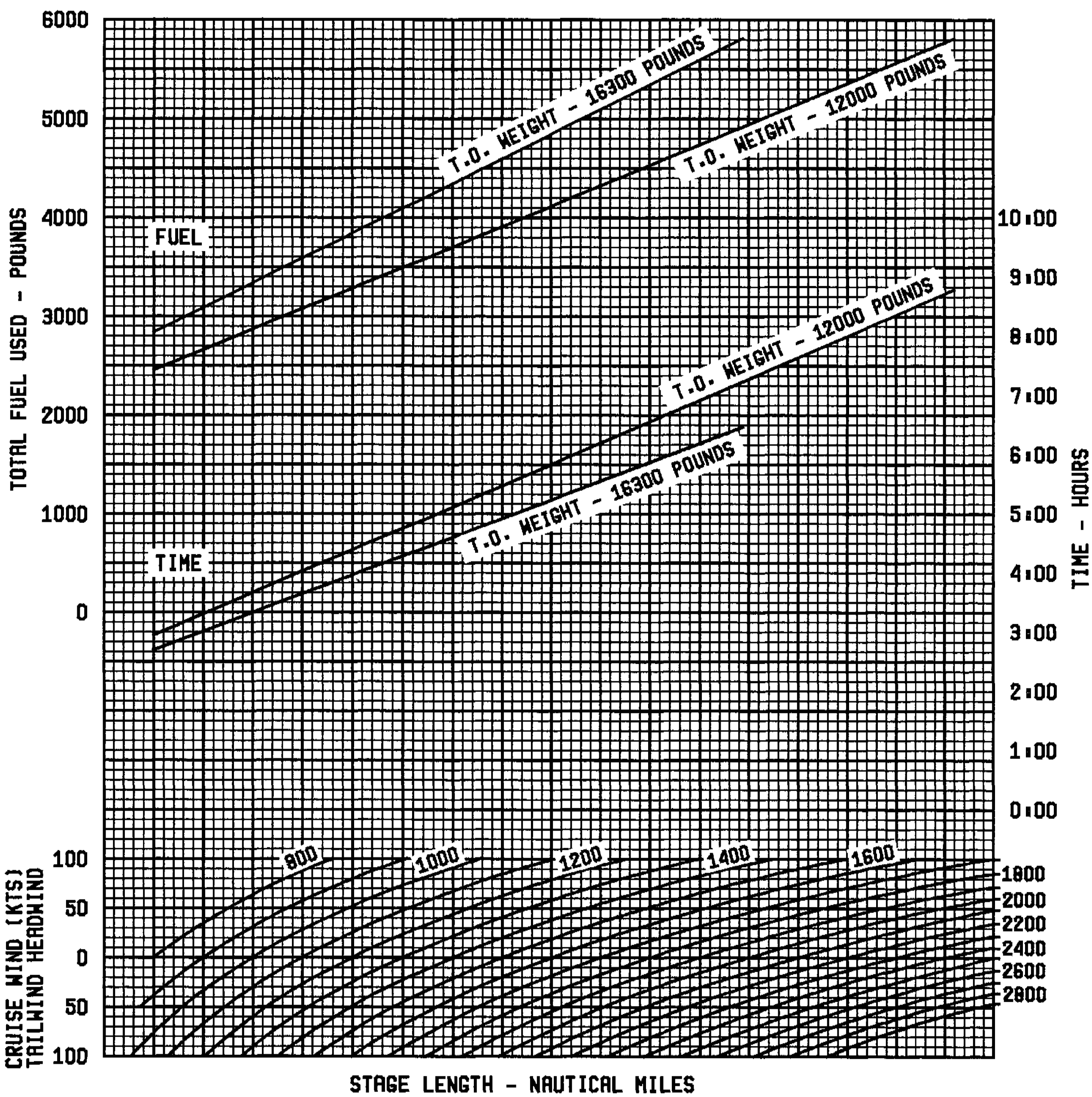


Figure 7-14 Long Range Cruise (Sheet 7 of 11)

LONG RANGE CRUISE

STANDARD DAY **CRUISE ALTITUDE 39000 FEET**

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS. 16000	15000	14000	13000	12000
TAILWIND	100	89.9	88.4	87.2	85.0	83.2
	50	90.2	88.8	87.4	85.6	83.8
	0	90.8	89.3	87.9	86.4	84.7
HEADWIND	50	92.1	90.1	88.6	87.5	85.9
	100	94.1	92.1	90.1	88.8	87.6

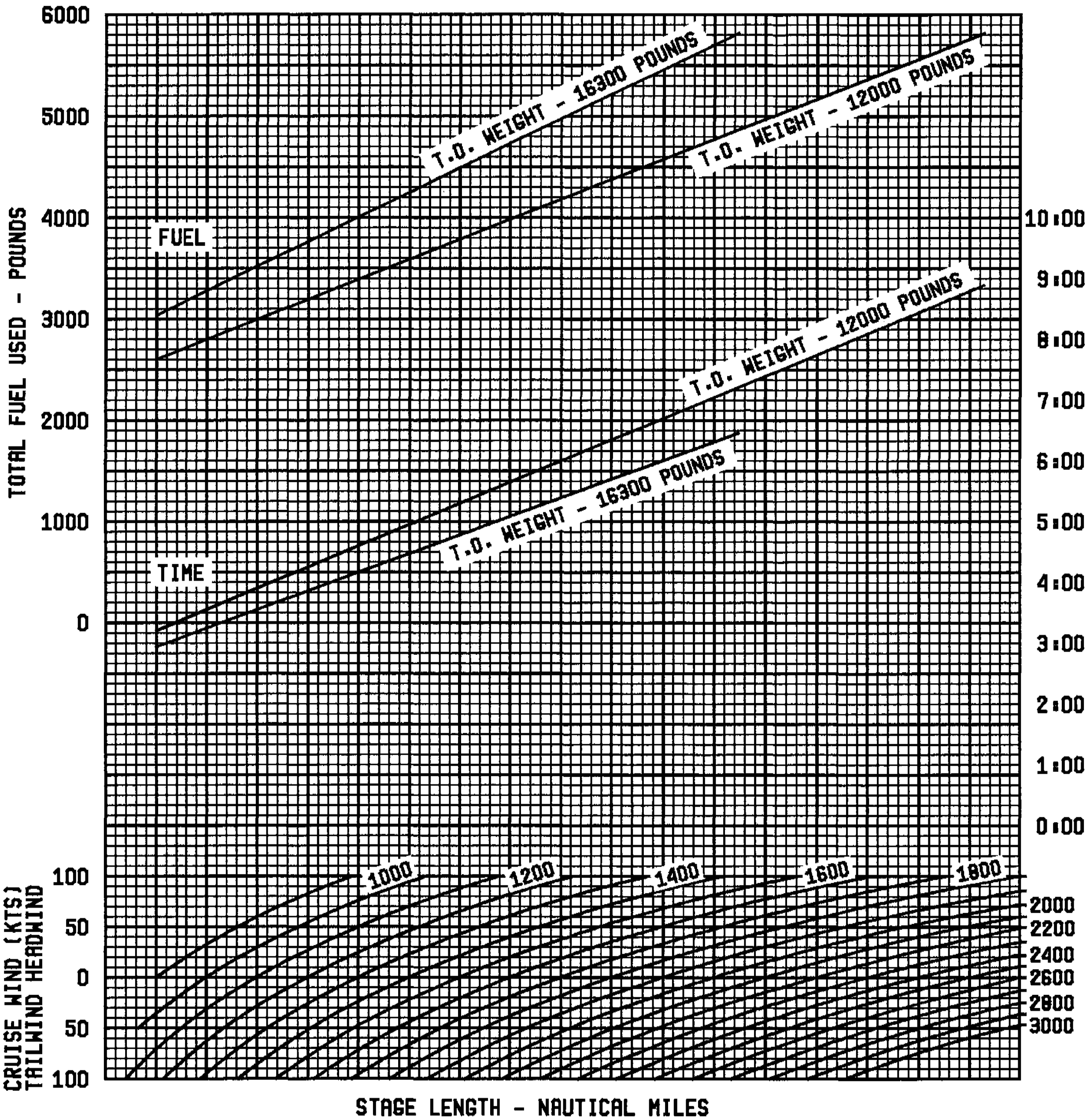


Figure 7-14 Long Range Cruise (Sheet 8 of 11)

LONG RANGE CRUISE

STANDARD DAY **CRUISE ALTITUDE 41000 FEET**

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS. 16000	15000	14000	13000	12000
TAILWIND	100	92.7	90.7	89.0	87.4	85.4
	50	93.2	91.1	89.4	87.8	86.0
	0	93.9	92.0	89.9	88.3	86.9
HEADWIND	50	95.1	93.2	90.8	89.1	87.7
	100	96.8	94.9	93.0	90.6	89.0

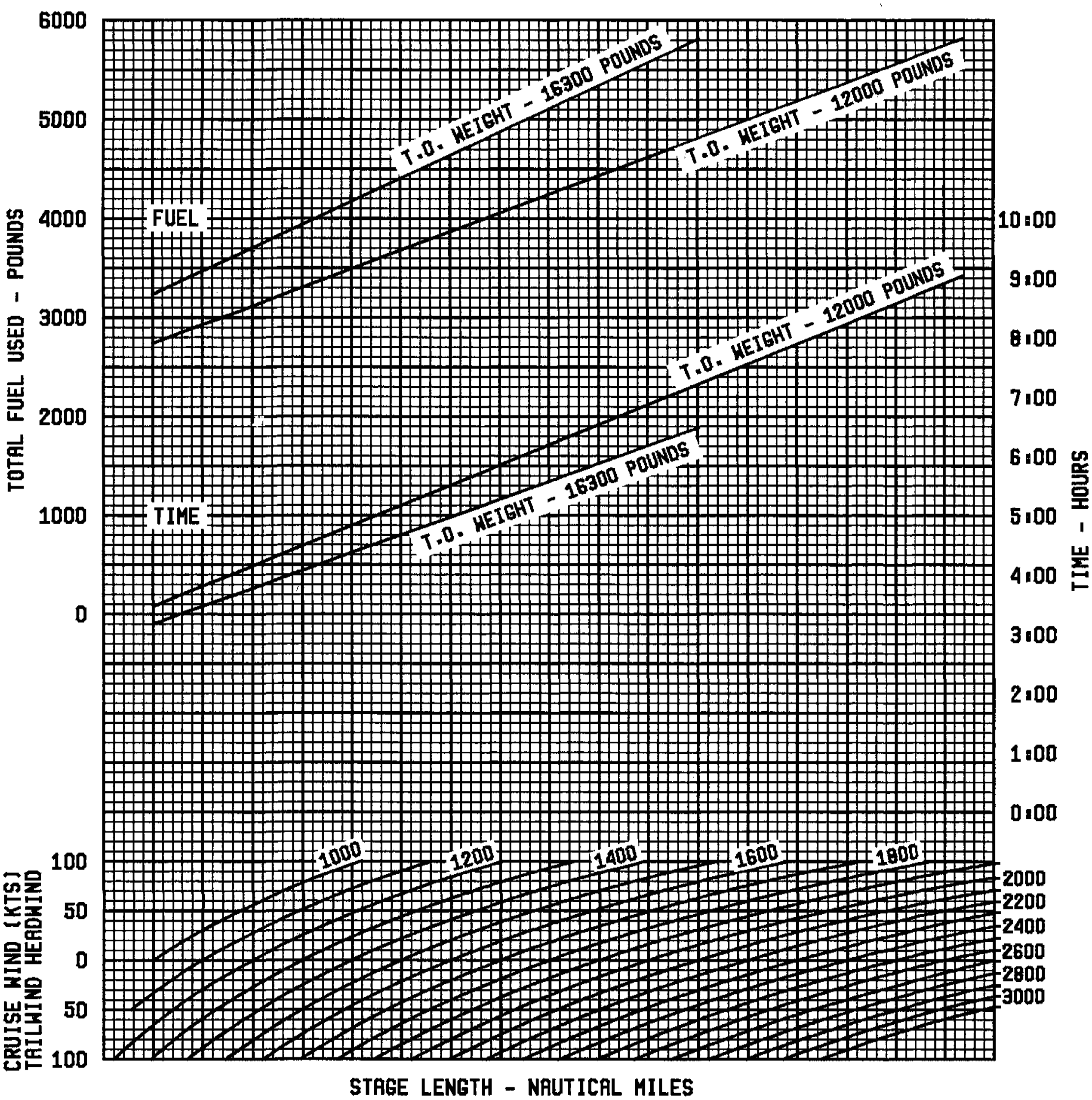


Figure 7-14 Long Range Cruise (Sheet 9 of 11)

LONG RANGE CRUISE

STANDARD DAY

CRUISE ALTITUDE 43000 FEET

FAN SETTING FOR LONG RANGE CRUISE

	WIND	CRUISE WEIGHT - LBS.				
	KNOTS	16000	15000	14000	13000	12000
TAILWIND	100	96.1	93.6	91.5	89.5	87.7
	50	96.7	94.2	92.0	90.2	88.1
	0	97.2	95.1	92.8	90.3	88.6
HEADWIND	50	98.1	96.2	94.0	91.6	90.0
	100	99.0	97.6	95.6	93.6	91.3

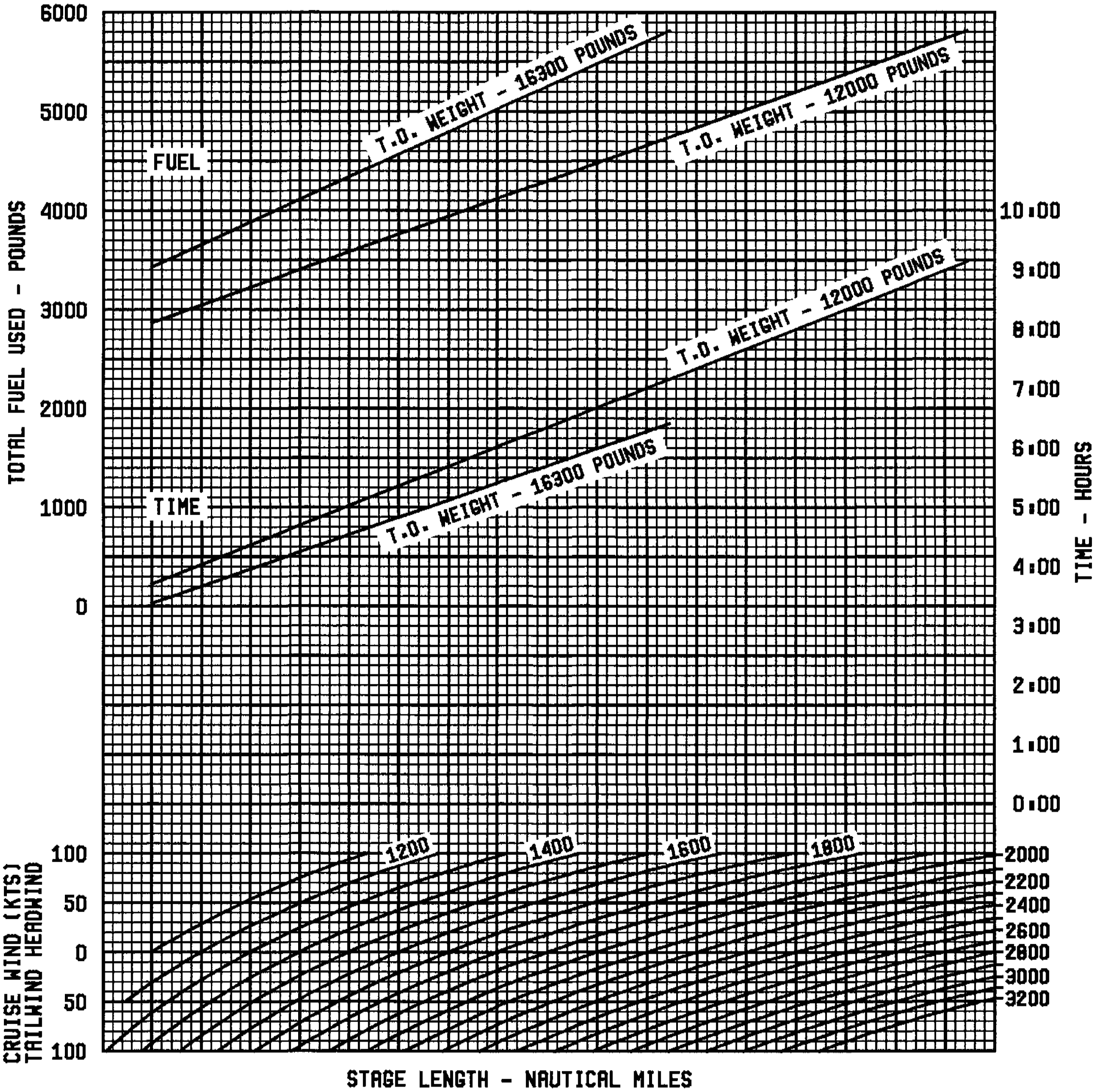


Figure 7-14 Long Range Cruise (Sheet 10 of 11)

LONG RANGE CRUISE

STANDARD DAY **CRUISE ALTITUDE 45000 FEET**

FAN SETTING FOR LONG RANGE CRUISE

	WIND KNOTS	CRUISE WEIGHT - LBS. 15500	15000	14000	13000	12000
TAILWIND	100	98.8	97.0	94.7	92.1	89.7
	50	98.8	97.4	95.2	93.0	90.3
	0	99.0	98.0	96.0	93.4	90.9
HEADWIND	50	99.0	98.9	97.0	94.7	92.2
	100	99.0	99.0	98.0	96.3	94.0

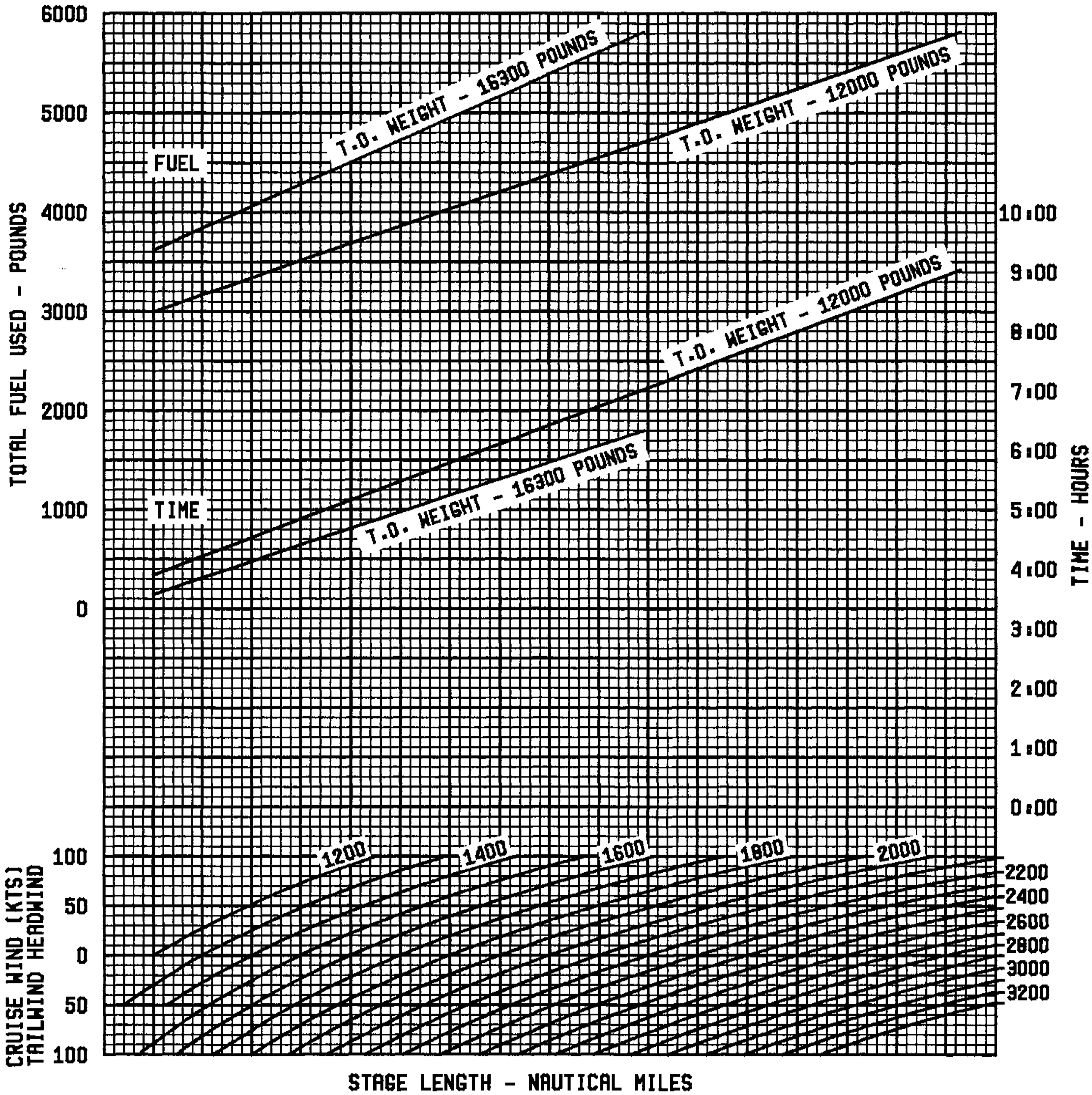


Figure 7-14 Long Range Cruise (Sheet 11 of 11)

TAKEOFF AND LANDING

Takeoff and landing performance is presented in tabulated form on the following pages. These data are for convenience in non-critical operations. The airplane flight manual contains all the mandatory performance data. Where any question exists regarding the correct values to be used or if the field length is critical, the airplane flight manual must be consulted and adhered to. In using the tabulated data, when the gross weight, ambient temperature, or altitude is between the values presented, the next higher value of each should be used. All the tabulated information is based on zero runway gradient. If runway gradient is significant, the airplane flight manual must be used. The obstacle clearance information is presented only in the airplane flight manual and must be consulted when obstacle clearance is a consideration. All data are based on smooth dry hard surface runway conditions. Proper judgment should be exercised if runway conditions are other than as stated.

TAKEOFF

The takeoff performance is based on setting takeoff thrust prior to starting the takeoff roll. Rotation is begun at V_R and continued to approximately 10 degrees nose up attitude. The landing gear may be retracted as soon as a positive rate of climb is established. The data, however, are based on the gear activation beginning at 35 feet. With one engine inoperative, the climb is continued to 400 feet at V_2. At 400 feet, the airplane is accelerated to V_2 +10 KIAS, the flaps raised and airplane is accelerated to V_{ENR}. Takeoff performance is based on maintaining takeoff power for 5 minutes, or until reaching 1500 feet above ground level (AGL), whichever occurs first. The thrust is set for single engine climb and the climb continued at single engine climb speed. Takeoff data is presented for 7° flaps and 15° flaps, with anti-ice on and anti-ice off.

If an engine is lost during takeoff prior to obtaining V_1 speed, heavy braking is initiated immediately if runway length is critical, throttles are retarded to idle and speedbrakes extended.

LANDING

The landing performance charts are based on flying a steady three degree approach at V_{REF} (1.3 V_{SO}) with full flaps extended, to 50 feet above the runway threshold. At that point, thrust is reduced to idle. The landing field length given includes distance from the threshold to touchdown.

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7°
LANDING - FLAPS FULL

PRESSURE ALTITUDE SEA LEVEL
ANTI-ICE SYSTEMS OFF

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	87.9	100	101	107	117	2860	2470	172	87.9	86.2			
	-20	89.7	99	101	107	117	2980	2570	172	89.7	87.9			
	-10	91.5	99	101	107	117	3090	2670	172	91.5	89.6			
	0	93.2	99	101	107	117	3210	2780	172	93.3	91.2			
	10	95.0	98	100	107	117	3320	2890	172	95.0	92.9			
	20	96.7	98	100	107	117	3470	3020	172	94.0	92.8			
	30	96.7	99	101	106	116	3740	3250	172	92.5	91.3			
	40	95.3	101	102	106	116	4200	3650	172	90.9	89.8			
16000	-30	87.9	98	100	106	116	2770	2380	171	87.9	86.2			
	-20	89.7	98	100	105	116	2870	2480	171	89.7	87.9			
	-10	91.5	98	100	106	116	2980	2580	171	91.5	89.6			
	0	93.2	98	99	105	116	3100	2680	171	93.3	91.2			
	10	95.0	97	99	105	116	3210	2790	171	95.0	92.9			
	20	96.7	97	99	105	116	3350	2910	171	94.0	92.8			
	30	96.7	98	100	105	115	3600	3140	171	92.5	91.3			
	40	95.3	100	101	105	115	4040	3520	171	90.9	89.8			
15200	-30	87.9	95	97	103	113	2530	2170	170	87.9	86.2	107	2450	2120
	-20	89.7	95	97	103	113	2620	2260	170	89.7	87.9	107	2530	2190
	-10	91.5	95	96	103	113	2720	2350	170	91.5	89.6	107	2610	2260
	0	93.2	94	96	103	113	2820	2440	170	93.2	91.2	107	2690	2330
	10	95.0	94	96	103	113	2920	2540	170	95.0	92.9	107	2770	2400
	20	96.7	94	96	103	113	3040	2640	170	94.0	92.8	107	2840	2480
	30	96.7	95	97	103	113	3260	2840	170	92.5	91.3	107	2930	2550
	40	95.3	97	98	103	113	3660	3180	170	90.9	89.8	107	3010	2620
14500	-30	87.9	92	94	100	111	2330	2000	169	87.9	86.2	105	2350	2040
	-20	89.7	92	94	100	111	2420	2080	169	89.7	87.9	105	2420	2100
	-10	91.5	92	94	100	111	2510	2170	169	91.4	89.6	105	2490	2170
	0	93.2	92	94	100	111	2600	2250	169	93.2	91.2	105	2570	2230
	10	95.0	92	93	100	111	2690	2330	169	95.0	92.9	105	2640	2300
	20	96.7	91	93	100	111	2810	2430	169	94.0	92.8	105	2710	2360
	30	96.7	92	94	100	111	2990	2600	169	92.5	91.3	105	2790	2430
	40	95.3	94	95	100	110	3340	2900	169	90.9	89.8	105	2860	2500
13500	-30	87.9	89	90	97	109	2090	1780	168	87.9	86.2	101	2210	1910
	-20	89.7	89	90	97	109	2170	1850	168	89.7	87.9	101	2270	1970
	-10	91.5	88	90	97	109	2250	1920	168	91.4	89.6	101	2340	2030
	0	93.2	88	90	97	109	2330	1990	168	93.2	91.2	101	2400	2090
	10	95.0	88	89	97	109	2420	2060	168	95.0	92.9	101	2470	2150
	20	96.7	87	89	97	108	2490	2150	168	94.0	92.8	101	2530	2210
	30	96.7	88	90	96	108	2650	2300	168	92.5	91.3	101	2600	2270
	40	95.3	89	91	96	107	2920	2540	168	90.9	89.8	101	2670	2330
12500	-30	87.9	89	89	94	107	2060	1690	167	87.9	86.2	98	2080	1790
	-20	89.7	89	89	94	107	2140	1760	167	89.6	87.9	98	2130	1850
	-10	91.5	89	89	94	107	2220	1840	167	91.4	89.6	98	2190	1900
	0	93.2	89	89	94	107	2300	1910	167	93.2	91.2	98	2250	1950
	10	95.0	89	89	93	106	2380	1970	167	95.0	92.9	98	2310	2010
	20	96.7	88	88	93	106	2440	2030	167	94.0	92.8	98	2360	2060
	30	96.7	86	86	93	105	2420	2020	167	92.5	91.3	98	2420	2110
	40	95.3	85	87	92	104	2560	2220	167	90.9	89.8	98	2480	2170
11500	-30	87.9	90	90	95	109	2040	1680	165	87.8	86.2	94	1940	1680
	-20	89.7	90	90	95	109	2120	1750	165	89.6	87.9	94	2000	1730
	-10	91.5	90	90	95	109	2200	1820	165	91.4	89.6	94	2050	1770
	0	93.2	90	90	95	109	2270	1890	165	93.2	91.2	94	2100	1820
	10	95.0	89	89	95	108	2350	1960	165	95.0	92.9	94	2150	1870
	20	96.7	89	89	94	108	2410	2010	165	94.0	92.8	94	2200	1920
	30	96.7	86	86	91	104	2380	1990	165	92.5	91.3	94	2250	1960
	40	95.3	81	82	88	101	2270	1920	165	90.9	89.8	94	2310	2010
10500	-30	87.9	91	91	96	111	2040	1690	164	87.8	86.2	90	1820	1580
	-20	89.7	91	91	96	111	2110	1760	164	89.6	87.9	90	1860	1620
	-10	91.5	91	91	96	111	2190	1820	164	91.4	89.6	90	1900	1660
	0	93.2	90	90	96	111	2260	1890	164	93.2	91.2	90	1950	1700
	10	95.0	90	90	96	111	2340	1950	164	95.0	92.9	90	2000	1740
	20	96.7	89	89	95	110	2390	2000	164	94.1	92.8	90	2040	1780
	30	96.7	87	87	92	106	2360	1970	164	92.6	91.3	90	2090	1820
	40	95.3	82	82	87	100	2230	1860	164	90.9	89.8	90	2130	1860

Figure 7-15. Takeoff and Landing (Sheet 1 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 1000 FEET
ANTI-ICE SYSTEMS OFF

WT	AMB. TEMP	TAKEOFF FAN	TAKEOFF V1 = KIAS		TAKEOFF VR	TAKEOFF V2	TAKEOFF FIELD LENGTH - FT		CLIMB VENR	CLIMB S.E. FAN	CLIMB M.E. FAN	LANDING VREF	LANDING DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	89.3	99	101	107	117	2940	2540	170	89.1	87.5			
	-20	91.1	99	101	107	117	3060	2650	170	90.9	89.2			
	-10	92.9	99	100	107	117	3180	2760	170	92.7	90.9			
	0	94.7	98	100	107	117	3300	2860	170	94.5	92.6			
	10	96.4	98	100	107	117	3420	2980	170	95.3	94.2			
	20	97.8	98	100	107	117	3640	3170	170	94.0	92.8			
	30	96.7	100	101	106	116	4000	3490	170	92.5	91.3			
	40	95.3	101	103	106	116	4510	3930	170	90.9	89.8			
16000	-30	89.3	98	100	106	116	2840	2450	170	89.1	87.5			
	-20	91.1	98	100	106	116	2960	2560	170	90.9	89.2			
	-10	92.9	97	99	106	116	3070	2660	170	92.7	90.9			
	0	94.7	97	99	106	116	3180	2760	170	94.5	92.6			
	10	96.4	97	99	106	116	3300	2870	170	95.3	94.2			
	20	97.8	97	99	105	116	3510	3060	170	94.0	92.8			
	30	96.7	98	100	105	115	3860	3360	170	92.5	91.3			
	40	95.3	100	102	105	115	4340	3780	170	90.9	89.8			
15200	-30	89.3	95	97	103	113	2600	2240	169	89.1	87.5	107	2530	2190
	-20	91.1	95	96	103	113	2700	2330	169	90.9	89.2	107	2610	2260
	-10	92.9	94	96	103	113	2800	2430	169	92.7	90.9	107	2690	2340
	0	94.7	94	96	103	113	2900	2520	169	94.5	92.6	107	2770	2410
	10	96.4	94	96	103	113	3010	2610	169	95.3	94.2	107	2860	2490
	20	97.8	94	96	103	113	3180	2770	169	94.0	92.8	107	2940	2560
	30	96.7	95	97	103	113	3490	3040	169	92.5	91.3	107	3030	2640
	40	95.3	97	99	103	113	3920	3410	169	90.9	89.8	107	3110	2710
14500	-30	89.3	92	94	100	111	2400	2070	168	89.1	87.5	105	2420	2100
	-20	91.1	92	94	100	111	2490	2150	168	90.9	89.2	105	2500	2170
	-10	92.9	92	93	100	111	2590	2240	168	92.7	90.9	105	2570	2230
	0	94.7	91	93	100	111	2680	2320	168	94.5	92.6	105	2650	2300
	10	96.4	91	93	100	111	2770	2410	168	95.3	94.2	105	2720	2370
	20	97.8	91	93	100	111	2930	2550	168	94.0	92.8	105	2800	2440
	30	96.7	93	94	100	110	3190	2780	168	92.5	91.3	105	2880	2510
	40	95.3	94	96	100	110	3580	3110	168	90.9	89.8	105	2960	2580
13500	-30	89.3	89	90	97	109	2180	1830	166	89.1	87.5	101	2270	1970
	-20	91.1	89	90	97	109	2260	1900	166	90.9	89.2	101	2340	2030
	-10	92.9	89	89	97	109	2350	1980	166	92.7	90.9	101	2410	2090
	0	94.7	89	89	97	109	2440	2050	166	94.5	92.6	101	2470	2150
	10	96.4	88	89	97	109	2520	2130	166	95.3	94.2	101	2540	2220
	20	97.8	88	89	96	108	2590	2250	166	94.0	92.8	101	2610	2280
	30	96.7	88	90	96	107	2810	2440	166	92.5	91.3	101	2680	2340
	40	95.3	90	91	96	107	3120	2710	166	90.9	89.8	101	2750	2400
12500	-30	89.3	90	90	94	107	2150	1770	165	89.0	87.5	98	2130	1850
	-20	91.1	89	89	94	107	2230	1840	165	90.9	89.2	98	2190	1900
	-10	92.9	89	89	94	107	2310	1920	165	92.7	90.9	98	2250	1960
	0	94.7	89	89	94	107	2400	1990	165	94.5	92.6	98	2310	2010
	10	96.4	89	89	94	107	2480	2070	165	95.3	94.2	98	2370	2070
	20	97.8	87	87	93	106	2500	2080	165	94.0	92.8	98	2430	2120
	30	96.7	84	86	93	105	2470	2140	165	92.5	91.3	98	2490	2180
	40	95.3	86	87	92	103	2720	2360	165	90.9	89.8	98	2560	2240
11500	-30	89.3	90	90	95	109	2130	1760	164	89.0	87.5	94	2000	1730
	-20	91.1	90	90	95	109	2210	1830	164	90.8	89.2	94	2050	1770
	-10	92.9	90	90	95	109	2290	1900	164	92.6	90.9	94	2100	1820
	0	94.7	90	90	95	109	2370	1980	164	94.5	92.6	94	2160	1870
	10	96.4	90	90	95	109	2450	2050	164	95.3	94.2	94	2210	1920
	20	97.8	88	88	93	107	2460	2060	164	94.0	92.8	94	2260	1970
	30	96.7	84	84	89	102	2390	1990	164	92.5	91.3	94	2320	2020
	40	95.3	81	83	88	100	2370	2050	164	90.9	89.8	94	2370	2070
10500	-30	89.3	91	91	97	111	2120	1760	163	89.0	87.5	90	1860	1620
	-20	91.1	91	91	97	111	2200	1830	163	90.8	89.2	90	1910	1660
	-10	92.9	91	91	97	111	2280	1900	163	92.6	90.9	90	1950	1700
	0	94.7	91	91	97	111	2360	1970	163	94.4	92.6	90	2000	1740
	10	96.4	90	90	97	111	2440	2040	163	95.3	94.2	90	2050	1790
	20	97.8	89	89	95	109	2440	2050	163	94.0	92.8	90	2100	1830
	30	96.7	85	85	90	104	2360	1970	163	92.5	91.3	90	2140	1870
	40	95.3	80	80	84	98	2230	1860	163	90.9	89.8	90	2190	1910

Figure 7-15. Takeoff and Landing (Sheet 2 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7° **PRESSURE ALTITUDE 2000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS OFF**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	90.6	99	101	107	117	3030	2620	169	90.3	88.8			
	-20	92.4	98	100	107	117	3150	2730	169	92.1	90.5			
	-10	94.3	98	100	107	117	3270	2840	169	93.9	92.3			
	0	96.1	98	100	107	117	3390	2950	169	95.7	94.0			
	10	97.9	98	99	107	117	3520	3070	169	95.3	94.2			
	20	97.8	99	100	107	116	3850	3360	169	94.0	92.8			
	30	96.7	100	102	106	116	4290	3750	169	92.5	91.3			
	40	95.3	102	103	106	116	4850	4230	169	90.9	89.7			
16000	-30	90.6	98	99	106	116	2920	2530	168	90.3	88.8			
	-20	92.4	97	99	106	116	3040	2640	168	92.1	90.5			
	-10	94.3	97	99	106	116	3160	2740	168	93.9	92.3			
	0	96.1	97	99	106	116	3270	2850	168	95.7	94.0			
	10	97.9	96	98	106	116	3400	2960	168	95.3	94.2			
	20	97.8	97	99	105	115	3710	3240	168	94.0	92.8			
	30	96.7	99	101	105	115	4130	3610	168	92.5	91.3			
	40	95.3	100	102	105	115	4660	4070	168	90.9	89.7			
15200	-30	90.6	94	96	103	113	2670	2310	167	90.3	88.8	107	2610	2260
	-20	92.4	94	96	103	113	2780	2410	167	92.1	90.5	107	2690	2340
	-10	94.3	94	96	103	113	2890	2500	167	93.9	92.3	107	2780	2410
	0	96.1	94	95	103	113	2990	2600	167	95.7	94.0	107	2860	2490
	10	97.9	93	95	103	113	3090	2690	167	95.3	94.2	107	2950	2570
	20	97.8	94	96	103	113	3360	2930	167	94.0	92.8	107	3040	2650
	30	96.7	96	98	103	113	3740	3260	167	92.5	91.3	107	3130	2730
	40	95.3	97	99	103	113	4200	3670	167	90.9	89.7	107	3220	2810
14500	-30	90.6	92	94	100	111	2470	2130	166	90.3	88.8	105	2490	2160
	-20	92.4	91	93	100	111	2570	2220	166	92.1	90.5	105	2570	2240
	-10	94.3	91	93	100	111	2660	2310	166	93.9	92.3	105	2650	2310
	0	96.1	91	93	100	111	2750	2390	166	95.7	94.0	105	2730	2380
	10	97.9	91	93	100	111	2860	2480	166	95.3	94.2	105	2810	2450
	20	97.8	92	93	100	111	3080	2680	166	94.0	92.8	105	2890	2520
	30	96.7	93	95	100	110	3410	2970	166	92.5	91.3	105	2970	2600
	40	95.3	95	96	100	110	3830	3340	166	90.9	89.7	105	3060	2670
13500	-30	90.6	89	90	97	109	2270	1890	165	90.3	88.8	101	2340	2030
	-20	92.4	89	89	97	109	2360	1960	165	92.1	90.5	101	2410	2090
	-10	94.3	89	89	97	109	2450	2040	165	93.9	92.3	101	2480	2160
	0	96.1	89	89	97	109	2550	2110	165	95.7	94.0	101	2550	2220
	10	97.9	89	89	97	109	2640	2190	165	95.3	94.2	101	2620	2290
	20	97.8	88	89	96	108	2730	2370	165	94.0	92.8	101	2690	2350
	30	96.7	89	90	96	107	2990	2600	165	92.5	91.3	101	2770	2420
	40	95.3	90	92	96	107	3340	2910	165	90.9	89.7	101	2840	2480
12500	-30	90.6	90	90	95	108	2240	1850	163	90.2	88.8	98	2190	1900
	-20	92.4	90	90	95	108	2320	1930	163	92.1	90.5	98	2260	1960
	-10	94.3	90	90	95	108	2410	2010	163	93.9	92.3	98	2320	2020
	0	96.1	89	89	95	108	2510	2090	163	95.7	94.0	98	2380	2070
	10	97.9	89	89	95	108	2590	2160	163	95.3	94.2	98	2440	2130
	20	97.8	86	86	93	105	2540	2110	163	94.0	92.8	98	2510	2190
	30	96.7	85	86	92	104	2620	2280	163	92.5	91.3	98	2570	2250
	40	95.3	86	87	92	103	2900	2520	163	90.9	89.7	98	2640	2310
11500	-30	90.6	91	91	96	110	2220	1840	162	90.2	88.8	94	2050	1770
	-20	92.4	90	90	96	110	2300	1910	162	92.0	90.5	94	2110	1830
	-10	94.3	90	90	96	110	2390	1990	162	93.9	92.3	94	2160	1880
	0	96.1	90	90	96	110	2480	2070	162	95.7	94.0	94	2220	1930
	10	97.9	90	90	96	110	2560	2140	162	95.3	94.2	94	2270	1980
	20	97.8	87	87	92	105	2500	2090	162	94.0	92.8	94	2330	2030
	30	96.7	82	82	88	101	2400	1990	162	92.5	91.3	94	2390	2080
	40	95.3	81	83	88	100	2520	2180	162	90.9	89.7	94	2440	2140
10500	-30	90.6	91	91	98	112	2210	1840	161	90.2	88.8	90	1910	1660
	-20	92.4	91	91	97	112	2290	1910	161	92.0	90.5	90	1960	1700
	-10	94.3	91	91	98	112	2380	1990	161	93.9	92.3	90	2010	1750
	0	96.1	91	91	98	112	2460	2070	161	95.7	94.0	90	2060	1790
	10	97.9	91	91	97	112	2540	2140	161	95.3	94.2	90	2110	1830
	20	97.8	87	87	93	107	2470	2070	161	94.0	92.8	90	2160	1880
	30	96.7	83	83	88	101	2360	1970	161	92.5	91.3	90	2210	1920
	40	95.3	78	78	84	97	2240	1860	161	90.9	89.7	90	2260	1970

Figure 7-15. Takeoff and Landing (Sheet 3 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7° **PRESSURE ALTITUDE 3000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS OFF**

WT	AMB. TEMP	TAKEOFF FAN	TAKEOFF V1 = KIAS		TAKEOFF VR	TAKEOFF V2	TAKEOFF FIELD LENGTH - FT		CLIMB VENR	CLIMB S.E. FAN	CLIMB M.E. FAN	LANDING VREF	LANDING DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	92.0	98	100	107	117	3120	2700	167	91.8	90.0			
	-20	93.8	98	100	107	117	3250	2820	167	93.6	91.8			
	-10	95.7	98	100	107	117	3370	2940	167	95.4	93.6			
	0	97.5	97	99	107	117	3510	3060	167	96.3	95.4			
	10	98.6	98	100	107	117	3720	3250	167	95.3	94.1			
	20	97.8	99	101	106	116	4120	3600	167	94.0	92.7			
	30	96.7	100	102	106	116	4610	4030	167	92.5	91.2			
	40	95.3	102	103	106	116	5220	4560	167	90.9	89.7			
16000	-30	92.0	97	99	106	116	3010	2610	167	91.8	90.0			
	-20	93.8	97	99	106	116	3140	2720	167	93.6	91.8			
	-10	95.7	97	98	106	116	3260	2830	167	95.4	93.6			
	0	97.5	96	98	106	116	3390	2950	167	96.3	95.4			
	10	98.6	97	98	105	116	3590	3130	167	95.3	94.1			
	20	97.8	98	100	105	115	3970	3470	167	94.0	92.7			
	30	96.7	99	101	105	115	4440	3880	167	92.5	91.2			
	40	95.3	101	102	105	115	5020	4390	167	90.9	89.7			
15200	-30	92.0	94	96	103	113	2760	2390	166	91.8	90.0	107	2690	2340
	-20	93.8	94	96	103	113	2870	2490	166	93.6	91.8	107	2780	2420
	-10	95.7	94	95	103	113	2980	2590	166	95.4	93.6	107	2870	2500
	0	97.5	93	95	103	113	3090	2690	166	96.3	95.4	107	2960	2580
	10	98.6	94	95	103	113	3260	2840	166	95.3	94.1	107	3050	2660
	20	97.8	95	97	103	113	3590	3130	166	94.0	92.7	107	3150	2740
	30	96.7	96	98	103	113	4010	3500	166	92.5	91.2	107	3240	2830
	40	95.3	98	99	103	113	4520	3950	166	90.9	89.7	107	3340	2910
14500	-30	92.0	91	93	100	112	2540	2200	165	91.8	90.0	105	2570	2230
	-20	93.8	91	93	100	112	2650	2290	165	93.6	91.8	105	2650	2310
	-10	95.7	91	93	100	112	2740	2380	165	95.4	93.6	105	2740	2380
	0	97.5	91	93	100	112	2850	2480	165	96.4	95.4	105	2820	2460
	10	98.6	91	93	100	111	3000	2620	165	95.3	94.1	105	2900	2530
	20	97.8	92	94	100	110	3280	2860	165	94.0	92.7	105	2990	2610
	30	96.7	94	95	100	110	3660	3190	165	92.5	91.2	105	3080	2690
	40	95.3	95	96	100	110	4110	3590	165	90.9	89.7	105	3170	2770
13500	-30	92.0	89	89	97	109	2360	1960	164	91.8	90.0	101	2410	2090
	-20	93.8	89	89	97	109	2460	2040	164	93.6	91.8	101	2480	2160
	-10	95.7	89	89	97	109	2560	2120	164	95.4	93.6	101	2560	2230
	0	97.5	89	89	97	109	2640	2200	164	96.4	95.4	101	2630	2290
	10	98.6	87	89	97	109	2680	2310	164	95.3	94.1	101	2700	2360
	20	97.8	88	90	96	108	2900	2520	164	94.0	92.7	101	2780	2430
	30	96.7	89	91	96	107	3190	2780	164	92.5	91.2	101	2860	2500
	40	95.3	91	92	96	107	3580	3120	164	90.9	89.7	101	2930	2570
12500	-30	92.0	90	90	95	108	2330	1930	162	91.8	90.0	98	2260	1960
	-20	93.8	90	90	95	108	2420	2010	162	93.6	91.8	98	2320	2020
	-10	95.7	90	90	95	108	2520	2100	162	95.4	93.6	98	2390	2080
	0	97.5	89	89	95	108	2600	2170	162	96.4	95.4	98	2450	2140
	10	98.6	88	88	93	106	2630	2200	162	95.3	94.1	98	2520	2200
	20	97.8	84	86	93	105	2550	2210	162	94.0	92.7	98	2580	2260
	30	96.7	85	87	92	104	2790	2420	162	92.5	91.2	98	2650	2320
	40	95.3	86	88	92	103	3100	2690	162	90.9	89.7	98	2720	2380
11500	-30	92.0	91	91	96	110	2310	1920	161	91.8	90.0	94	2110	1830
	-20	93.8	91	91	96	110	2400	2000	161	93.6	91.8	94	2160	1880
	-10	95.7	90	90	96	110	2490	2080	161	95.3	93.6	94	2220	1930
	0	97.5	90	90	96	110	2570	2150	161	96.4	95.4	94	2280	1990
	10	98.6	89	89	94	108	2600	2180	161	95.3	94.1	94	2340	2040
	20	97.8	85	85	90	103	2510	2090	161	94.0	92.7	94	2400	2100
	30	96.7	81	82	88	101	2420	2100	161	92.5	91.2	94	2460	2150
	40	95.3	82	83	88	100	2670	2320	161	90.9	89.7	94	2520	2210
10500	-30	92.0	92	92	98	113	2300	1920	159	91.8	90.0	90	1960	1710
	-20	93.8	91	91	98	113	2390	2000	159	93.5	91.8	90	2010	1750
	-10	95.7	91	91	98	113	2470	2080	159	95.3	93.6	90	2060	1800
	0	97.5	91	91	98	112	2550	2150	159	96.4	95.4	90	2110	1840
	10	98.6	89	89	96	110	2580	2170	159	95.3	94.1	90	2160	1890
	20	97.8	85	85	91	105	2480	2080	159	94.0	92.7	90	2220	1930
	30	96.7	81	81	85	99	2360	1970	159	92.5	91.2	90	2270	1980
	40	95.3	77	78	84	96	2290	1980	159	90.9	89.7	90	2320	2030

Figure 7-15. Takeoff and Landing (Sheet 4 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 4000 FEET
ANTI-ICE SYSTEMS OFF

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	93.4	98	100	107	117	3220	2790	166	93.4	91.3			
	-20	95.3	97	99	107	117	3350	2910	166	95.1	93.1			
	-10	97.1	97	99	107	117	3480	3040	166	96.9	95.0			
	0	99.0	97	99	107	117	3660	3200	166	96.3	95.4			
	10	98.6	98	100	107	116	3970	3470	166	95.3	94.1			
	20	97.8	99	101	106	116	4430	3870	166	94.0	92.7			
	30	96.7	101	102	106	116	4970	4350	166	92.5	91.2			
	40	95.3	102	104	106	116	5620	4920	166	90.8	89.7			
16000	-30	93.4	97	99	106	116	3110	2700	166	93.4	91.3			
	-20	95.3	96	98	106	116	3230	2810	166	95.1	93.1			
	-10	97.1	96	98	106	116	3360	2930	166	96.9	95.0			
	0	99.0	96	98	106	116	3530	3080	166	96.3	95.4			
	10	98.6	97	99	105	116	3830	3340	166	95.3	94.1			
	20	97.8	98	100	105	115	4260	3730	166	94.0	92.7			
	30	96.7	100	101	105	115	4780	4180	166	92.5	91.2			
	40	95.3	101	103	105	115	5410	4730	166	90.8	89.7			
15200	-30	93.4	94	96	103	114	2840	2470	165	93.4	91.3	107	2780	2420
	-20	95.3	93	95	103	113	2960	2570	165	95.1	93.1	107	2870	2500
	-10	97.1	93	95	103	113	3070	2670	165	96.9	95.0	107	2970	2580
	0	99.0	93	95	103	113	3220	2810	165	96.3	95.4	107	3060	2670
	10	98.6	94	96	103	113	3460	3020	165	95.3	94.1	107	3160	2750
	20	97.8	95	97	103	113	3850	3360	165	94.0	92.7	107	3260	2840
	30	96.7	97	98	103	113	4310	3770	165	92.5	91.2	107	3360	2930
	40	95.3	98	100	102	113	4860	4250	165	90.9	89.7	107	3470	3020
14500	-30	93.4	91	93	100	112	2620	2270	163	93.3	91.3	105	2650	2310
	-20	95.3	91	93	100	112	2730	2370	163	95.1	93.1	105	2740	2390
	-10	97.1	91	92	100	112	2830	2460	163	96.8	95.0	105	2830	2460
	0	99.0	91	92	100	111	2970	2580	163	96.4	95.4	105	2910	2540
	10	98.6	91	93	100	111	3180	2770	163	95.3	94.1	105	3000	2620
	20	97.8	93	94	100	110	3510	3070	163	94.0	92.7	105	3090	2700
	30	96.7	94	96	100	110	3920	3430	163	92.5	91.2	105	3190	2780
	40	95.3	95	97	100	110	4410	3860	163	90.9	89.7	105	3280	2870
13500	-30	93.4	90	90	97	109	2470	2040	162	93.3	91.3	101	2480	2160
	-20	95.3	89	89	97	109	2570	2130	162	95.1	93.1	101	2560	2230
	-10	97.1	89	89	97	109	2670	2220	162	96.8	95.0	101	2640	2300
	0	99.0	88	89	97	109	2730	2280	162	96.4	95.4	101	2710	2370
	10	98.6	87	89	96	108	2810	2450	162	95.3	94.1	101	2790	2440
	20	97.8	88	90	96	107	3080	2690	162	94.0	92.7	101	2870	2510
	30	96.7	90	91	96	107	3420	2980	162	92.5	91.2	101	2950	2580
	40	95.3	91	93	96	107	3840	3350	162	90.9	89.7	101	3030	2660
12500	-30	93.4	90	90	96	109	2430	2020	161	93.3	91.3	98	2320	2020
	-20	95.3	90	90	96	109	2530	2110	161	95.1	93.1	98	2390	2080
	-10	97.1	90	90	95	109	2620	2190	161	96.8	95.0	98	2460	2140
	0	99.0	89	89	94	108	2680	2240	161	96.4	95.4	98	2530	2210
	10	98.6	86	86	93	105	2660	2220	161	95.3	94.1	98	2590	2270
	20	97.8	84	86	92	104	2700	2350	161	94.0	92.7	98	2660	2330
	30	96.7	85	87	92	103	2970	2580	161	92.5	91.2	98	2730	2400
	40	95.3	87	88	92	103	3310	2880	161	90.9	89.7	98	2810	2460
11500	-30	93.4	91	91	97	111	2410	2010	159	93.3	91.3	94	2170	1880
	-20	95.3	91	91	97	111	2500	2090	159	95.1	93.1	94	2230	1940
	-10	97.1	91	91	97	111	2590	2170	159	96.8	95.0	94	2290	1990
	0	99.0	90	90	96	110	2650	2220	159	96.4	95.4	94	2350	2050
	10	98.6	87	87	92	106	2620	2190	159	95.3	94.1	94	2410	2100
	20	97.8	83	83	88	101	2510	2100	159	94.0	92.7	94	2470	2160
	30	96.7	81	82	88	100	2580	2240	159	92.5	91.2	94	2530	2220
	40	95.3	82	84	88	99	2840	2470	159	90.9	89.7	94	2590	2280
10500	-30	93.4	92	92	99	113	2400	2010	158	93.3	91.3	90	2010	1750
	-20	95.3	92	92	99	113	2490	2090	158	95.1	93.1	90	2070	1800
	-10	97.1	91	91	98	113	2580	2170	158	96.8	95.0	90	2120	1850
	0	99.0	90	90	97	112	2630	2210	158	96.4	95.4	90	2170	1890
	10	98.6	88	88	94	108	2590	2180	158	95.3	94.1	90	2230	1940
	20	97.8	83	83	88	102	2480	2070	158	94.0	92.7	90	2280	1990
	30	96.7	79	79	84	97	2370	1970	158	92.5	91.2	90	2330	2040
	40	95.3	77	79	84	96	2440	2110	158	90.9	89.7	90	2390	2090

Figure 7-15. Takeoff and Landing (Sheet 5 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 5000 FEET
ANTI-ICE SYSTEMS OFF

WT	AMB. TEMP	TAKEOFF: FAN	TAKEOFF: V1 = KIAS		TAKEOFF: VR	TAKEOFF: V2	TAKEOFF: FIELD LENGTH - FT		CLIMB: VENR	CLIMB: S.E. FAN	CLIMB: M.E. FAN	LANDING: VREF	LANDING: DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	95.3	97	99	107	117	3300	2880	165	94.9	92.6			
	-20	97.2	97	99	107	117	3450	3010	165	96.6	94.4			
	-10	99.0	97	99	107	117	3640	3180	165	97.3	96.3			
	0	99.0	98	99	107	117	3900	3410	165	96.3	95.4			
	10	98.6	99	100	106	116	4270	3740	165	95.3	94.1			
	20	97.8	100	102	106	116	4760	4170	165	94.0	92.6			
	30	96.7	101	103	106	116	5350	4690	165	92.5	91.2			
	40	95.3	103	104	106	116	6080	5320	165	90.8	89.6			
16000	-30	95.3	96	98	106	116	3190	2780	164	94.9	92.6			
	-20	97.2	96	98	106	116	3330	2900	164	96.6	94.4			
	-10	99.0	96	98	106	116	3510	3070	164	97.3	96.3			
	0	99.0	96	98	105	116	3760	3290	164	96.3	95.4			
	10	98.6	97	99	105	115	4110	3600	164	95.3	94.1			
	20	97.8	99	100	105	115	4580	4010	164	94.0	92.6			
	30	96.7	100	102	105	115	5150	4510	164	92.5	91.2			
	40	95.3	102	103	105	115	5830	5110	164	90.8	89.6			
15200	-30	95.3	93	95	103	114	2920	2540	163	94.9	92.6	107	2870	2500
	-20	97.2	93	95	103	114	3050	2650	163	96.5	94.4	107	2970	2590
	-10	99.0	93	95	103	113	3200	2790	163	97.3	96.3	107	3070	2670
	0	99.0	93	95	103	113	3410	2980	163	96.3	95.4	107	3170	2760
	10	98.6	94	96	103	113	3720	3250	163	95.3	94.1	107	3280	2860
	20	97.8	96	97	103	113	4130	3620	163	94.0	92.6	107	3380	2950
	30	96.7	97	99	103	113	4630	4050	163	92.5	91.2	107	3490	3040
	40	95.3	99	100	102	113	5230	4580	163	90.9	89.6	107	3600	3140
14500	-30	95.3	91	92	100	112	2690	2340	162	94.9	92.6	105	2740	2380
	-20	97.2	90	92	100	112	2810	2440	162	96.5	94.4	105	2830	2470
	-10	99.0	90	92	100	112	2950	2570	162	97.3	96.3	105	2920	2550
	0	99.0	91	93	100	111	3140	2740	162	96.3	95.4	105	3010	2630
	10	98.6	92	93	100	110	3400	2970	162	95.3	94.1	105	3110	2710
	20	97.8	93	95	100	110	3770	3290	162	94.0	92.6	105	3200	2800
	30	96.7	94	96	100	110	4210	3680	162	92.5	91.2	105	3300	2880
	40	95.3	96	97	100	110	4750	4150	162	90.9	89.6	105	3400	2970
13500	-30	95.3	90	90	97	109	2580	2150	160	94.8	92.6	101	2560	2230
	-20	97.2	90	90	97	109	2680	2230	160	96.5	94.4	101	2640	2300
	-10	99.0	89	89	97	109	2740	2290	160	97.3	96.3	101	2720	2380
	0	99.0	87	89	97	108	2770	2420	160	96.4	95.4	101	2800	2450
	10	98.6	88	89	96	108	3000	2610	160	95.3	94.1	101	2880	2520
	20	97.8	89	90	96	107	3290	2870	160	94.0	92.6	101	2970	2600
	30	96.7	90	92	96	107	3660	3200	160	92.5	91.2	101	3050	2670
	40	95.3	92	93	96	107	4120	3600	160	90.9	89.6	101	3140	2750
12500	-30	95.3	91	91	96	110	2550	2120	159	94.8	92.6	98	2390	2080
	-20	97.2	90	90	96	109	2640	2210	159	96.5	94.4	98	2460	2150
	-10	99.0	89	89	95	108	2700	2260	159	97.3	96.3	98	2530	2210
	0	99.0	87	87	93	106	2710	2270	159	96.4	95.4	98	2600	2280
	10	98.6	84	85	93	105	2660	2290	159	95.3	94.1	98	2680	2340
	20	97.8	85	86	92	104	2880	2500	159	94.0	92.6	98	2750	2410
	30	96.7	86	87	92	103	3170	2760	159	92.5	91.2	98	2820	2480
	40	95.3	87	89	92	103	3550	3100	159	90.9	89.6	98	2900	2550
11500	-30	95.3	91	91	98	112	2520	2110	158	94.8	92.6	94	2230	1940
	-20	97.2	91	91	97	111	2610	2190	158	96.5	94.4	94	2290	2000
	-10	99.0	90	90	96	110	2660	2230	158	97.3	96.3	94	2350	2050
	0	99.0	88	88	94	108	2670	2240	158	96.4	95.4	94	2420	2110
	10	98.6	85	85	90	103	2620	2190	158	95.3	94.1	94	2480	2170
	20	97.8	81	82	88	101	2520	2170	158	94.0	92.6	94	2550	2230
	30	96.7	81	83	88	100	2740	2380	158	92.5	91.2	94	2610	2290
	40	95.3	83	84	88	99	3040	2650	158	90.9	89.6	94	2680	2350
10500	-30	95.3	92	92	99	114	2510	2110	157	94.8	92.6	90	2070	1800
	-20	97.2	92	92	99	114	2600	2190	157	96.5	94.4	90	2120	1850
	-10	99.0	91	91	98	112	2650	2230	157	97.3	96.3	90	2180	1900
	0	99.0	89	89	95	110	2640	2230	157	96.4	95.4	90	2240	1950
	10	98.6	85	85	91	105	2580	2170	157	95.3	94.1	90	2290	2000
	20	97.8	81	81	86	100	2480	2080	157	94.0	92.6	90	2350	2050
	30	96.7	77	78	84	97	2380	2040	157	92.5	91.2	90	2400	2110
	40	95.3	78	79	84	96	2590	2240	157	90.9	89.6	90	2460	2160

Figure 7-15. Takeoff and Landing (Sheet 6 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 6000 FEET
ANTI-ICE SYSTEMS OFF

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	97.3	97	99	107	117	3400	2960	164	96.4	94.7			
	-20	99.0	97	99	107	117	3560	3110	164	98.0	96.5			
	-10	99.0	97	99	107	117	3840	3360	164	97.2	96.4			
	0	99.0	98	100	107	116	4170	3650	164	96.3	95.3			
	10	98.6	99	101	106	116	4600	4030	164	95.3	94.0			
	20	97.8	100	102	106	116	5130	4500	164	94.0	92.6			
	30	96.7	102	103	106	116	5780	5060	164	92.5	91.1			
16000	-30	97.3	96	98	106	116	3290	2870	163	96.4	94.7			
	-20	99.0	96	97	106	116	3440	3000	163	98.0	96.5			
	-10	99.0	96	98	106	116	3700	3240	163	97.3	96.4			
	0	99.0	97	99	105	115	4020	3520	163	96.3	95.3			
	10	98.6	98	100	105	115	4430	3880	163	95.3	94.0			
	20	97.8	99	101	105	115	4940	4320	163	94.0	92.6			
	30	96.7	101	102	105	115	5550	4870	163	92.5	91.1			
15200	-30	97.3	93	95	103	114	3010	2620	162	96.4	94.7	107	2970	2590
	-20	99.0	93	95	103	114	3140	2740	162	98.0	96.5	107	3080	2680
	-10	99.0	93	95	103	113	3370	2940	162	97.3	96.4	107	3180	2770
	0	99.0	94	96	103	113	3630	3180	162	96.3	95.3	107	3290	2870
	10	98.6	95	97	103	113	4000	3500	162	95.3	94.0	107	3400	2960
	20	97.8	96	98	103	113	4440	3890	162	94.0	92.6	107	3510	3060
	30	96.7	98	99	102	113	4980	4370	162	92.5	91.1	107	3630	3160
	40	95.3	99	100	102	113	5640	4940	162	90.8	89.6	107	3740	3260
14500	-30	97.3	90	92	100	112	2770	2410	161	96.4	94.7	105	2830	2470
	-20	99.0	90	92	100	112	2900	2530	161	98.0	96.5	105	2930	2550
	-10	99.0	90	92	100	111	3100	2710	161	97.3	96.4	105	3020	2640
	0	99.0	91	93	100	111	3330	2910	161	96.3	95.3	105	3120	2720
	10	98.6	92	94	100	110	3650	3190	161	95.3	94.0	105	3220	2810
	20	97.8	94	95	100	110	4050	3540	161	94.0	92.6	105	3320	2900
	30	96.7	95	96	100	110	4530	3960	161	92.5	91.1	105	3420	2990
	40	95.3	96	97	100	110	5120	4480	161	90.9	89.6	105	3530	3080
13500	-30	97.3	91	91	97	109	2710	2260	159	96.3	94.7	101	2640	2300
	-20	99.0	90	90	97	109	2800	2340	159	98.0	96.5	101	2730	2380
	-10	99.0	88	88	97	109	2810	2390	159	97.3	96.4	101	2810	2460
	0	99.0	87	89	96	108	2940	2570	159	96.3	95.3	101	2900	2530
	10	98.6	88	90	96	107	3190	2790	159	95.3	94.0	101	2980	2610
	20	97.8	89	91	96	107	3520	3080	159	94.0	92.6	101	3070	2690
	30	96.7	91	92	96	107	3930	3440	159	92.5	91.1	101	3160	2770
	40	95.3	92	93	96	107	4420	3870	159	90.9	89.6	101	3250	2850
12500	-30	97.3	91	91	97	110	2670	2230	158	96.3	94.7	98	2460	2150
	-20	99.0	91	91	96	110	2760	2310	158	98.0	96.5	98	2540	2210
	-10	99.0	88	88	94	107	2750	2310	158	97.3	96.4	98	2610	2280
	0	99.0	86	86	93	105	2730	2290	158	96.4	95.3	98	2690	2350
	10	98.6	84	86	93	104	2800	2440	158	95.3	94.0	98	2760	2420
	20	97.8	85	86	92	103	3060	2670	158	94.0	92.6	98	2840	2490
	30	96.7	86	88	92	103	3390	2960	158	92.5	91.1	98	2920	2560
	40	95.3	88	89	92	103	3810	3330	158	90.9	89.6	98	3000	2630
11500	-30	97.3	92	92	98	113	2640	2210	156	96.3	94.7	94	2290	2000
	-20	99.0	91	91	98	112	2720	2290	156	97.9	96.5	94	2360	2060
	-10	99.0	89	89	95	109	2720	2280	156	97.3	96.4	94	2430	2120
	0	99.0	86	86	92	105	2690	2250	156	96.4	95.3	94	2490	2180
	10	98.6	83	83	88	101	2620	2190	156	95.3	94.0	94	2560	2240
	20	97.8	81	82	88	100	2660	2310	156	94.0	92.6	94	2620	2300
	30	96.7	82	83	88	99	2920	2540	156	92.5	91.1	94	2690	2360
	40	95.3	83	84	88	99	3250	2830	156	90.9	89.6	94	2760	2430
10500	-30	97.3	93	93	100	115	2630	2210	155	96.3	94.7	90	2130	1850
	-20	99.0	92	92	100	114	2710	2280	155	97.9	96.5	90	2180	1900
	-10	99.0	90	90	97	111	2690	2270	155	97.3	96.4	90	2240	1960
	0	99.0	87	87	93	107	2650	2230	155	96.4	95.3	90	2300	2010
	10	98.6	83	83	89	102	2580	2170	155	95.3	94.0	90	2360	2060
	20	97.8	79	79	84	97	2480	2080	155	94.0	92.6	90	2420	2120
	30	96.7	77	78	84	96	2500	2170	155	92.5	91.1	90	2480	2170
	40	95.3	78	79	84	95	2760	2390	155	90.9	89.6	90	2540	2230

Figure 7-15. Takeoff and Landing (Sheet 7 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7° **PRESSURE ALTITUDE 7000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS OFF**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	99.0	97	99	107	117	3580	3120	163	98.8	96.8			
	-20	99.0	97	99	107	117	3820	3340	163	98.1	97.3			
	-10	99.0	98	100	107	116	4130	3620	163	97.2	96.4			
	0	99.0	98	100	106	116	4480	3930	163	96.3	95.3			
	10	98.6	99	101	106	116	4950	4340	163	95.2	94.0			
	20	97.8	101	102	106	116	5540	4860	163	94.0	92.6			
	30	96.7	102	103	106	116	6250	5480	163	92.4	91.1			
16000	-30	99.0	96	98	106	116	3450	3010	162	98.8	96.8			
	-20	99.0	96	98	106	116	3680	3220	162	98.1	97.3			
	-10	99.0	97	98	105	116	3980	3480	162	97.2	96.4			
	0	99.0	97	99	105	115	4320	3780	162	96.3	95.3			
	10	98.6	98	100	105	115	4770	4180	162	95.2	94.0			
	20	97.8	100	101	105	115	5320	4670	162	94.0	92.6			
	30	96.7	101	102	105	115	6000	5260	162	92.4	91.1			
15200	-30	99.0	93	95	103	114	3160	2750	161	98.8	96.8	107	3080	2680
	-20	99.0	93	95	103	113	3350	2920	161	98.1	97.3	107	3190	2780
	-10	99.0	94	95	103	113	3600	3150	161	97.2	96.4	107	3300	2870
	0	99.0	94	96	103	113	3900	3420	161	96.3	95.3	107	3410	2970
	10	98.6	95	97	103	113	4300	3770	161	95.3	94.0	107	3530	3080
	20	97.8	97	98	103	113	4780	4190	161	94.0	92.6	107	3650	3180
	30	96.7	98	99	102	113	5380	4720	161	92.5	91.1	107	3770	3290
14500	-30	99.0	90	92	100	112	2910	2530	160	98.8	96.8	105	2930	2550
	-20	99.0	90	92	100	111	3080	2690	160	98.1	97.3	105	3030	2640
	-10	99.0	91	93	100	111	3300	2890	160	97.3	96.4	105	3130	2730
	0	99.0	92	93	100	110	3560	3120	160	96.3	95.3	105	3230	2820
	10	98.6	93	94	100	110	3920	3430	160	95.3	94.0	105	3340	2920
	20	97.8	94	95	100	110	4350	3810	160	94.0	92.6	105	3440	3010
	30	96.7	95	97	100	110	4880	4280	160	92.5	91.1	105	3550	3110
	40	95.3	97	98	100	110	5520	4840	160	90.8	89.5	105	3670	3200
13500	-30	99.0	90	90	97	109	2770	2310	158	98.8	96.8	101	2730	2380
	-20	99.0	88	88	97	109	2820	2380	158	98.1	97.3	101	2820	2460
	-10	99.0	87	89	96	108	2920	2550	158	97.3	96.4	101	2900	2540
	0	99.0	88	89	96	107	3140	2740	158	96.3	95.3	101	2990	2620
	10	98.6	89	90	96	107	3410	2980	158	95.3	94.0	101	3090	2700
	20	97.8	90	91	96	107	3780	3310	158	94.0	92.6	101	3180	2790
	30	96.7	91	93	96	107	4230	3700	158	92.5	91.1	101	3270	2870
	40	95.3	93	94	96	107	4770	4180	158	90.9	89.5	101	3370	2960
12500	-30	99.0	90	90	96	109	2730	2280	156	98.8	96.8	98	2540	2220
	-20	99.0	89	89	94	107	2770	2320	156	98.1	97.3	98	2620	2290
	-10	99.0	86	86	93	105	2760	2310	156	97.3	96.4	98	2700	2360
	0	99.0	83	85	93	105	2750	2400	156	96.4	95.3	98	2770	2430
	10	98.6	84	86	92	104	2980	2600	156	95.3	94.0	98	2850	2500
	20	97.8	85	87	92	103	3270	2850	156	94.0	92.6	98	2930	2580
	30	96.7	87	88	92	103	3640	3180	156	92.5	91.1	98	3020	2650
	40	95.3	88	89	92	103	4090	3580	156	90.9	89.5	98	3100	2730
11500	-30	99.0	91	91	97	111	2690	2260	155	98.8	96.8	94	2360	2060
	-20	99.0	89	89	95	109	2730	2290	155	98.1	97.3	94	2430	2120
	-10	99.0	87	87	92	106	2720	2280	155	97.3	96.4	94	2500	2190
	0	99.0	84	84	89	103	2690	2260	155	96.4	95.3	94	2570	2250
	10	98.6	81	82	88	101	2630	2260	155	95.3	94.0	94	2640	2310
	20	97.8	81	82	88	100	2830	2470	155	94.0	92.6	94	2710	2380
	30	96.7	82	83	88	99	3110	2720	155	92.5	91.1	94	2780	2440
	40	95.3	84	85	88	99	3490	3040	155	90.9	89.5	94	2850	2510
10500	-30	99.0	92	92	99	114	2680	2260	154	98.8	96.8	90	2190	1900
	-20	99.0	90	90	97	111	2710	2280	154	98.1	97.3	90	2250	1960
	-10	99.0	87	87	94	108	2680	2260	154	97.3	96.4	90	2310	2020
	0	99.0	85	85	91	105	2650	2230	154	96.4	95.3	90	2370	2070
	10	98.6	81	81	86	100	2580	2170	154	95.3	94.0	90	2430	2130
	20	97.8	77	78	84	97	2490	2100	154	94.0	92.6	90	2490	2190
	30	96.7	77	79	84	96	2660	2310	154	92.5	91.1	90	2550	2240
	40	95.3	79	80	84	95	2940	2560	154	90.9	89.5	90	2620	2300

Figure 7-15. Takeoff and Landing (Sheet 8 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7°
LANDING - FLAPS FULL

PRESSURE ALTITUDE SEA LEVEL
ANTI-ICE SYSTEMS ON

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	87.9	100	101	107	117	3320	2870	172	87.9	86.2			
	-20	89.7	99	101	107	117	3460	2980	172	89.7	87.9			
	-10	91.5	99	101	107	117	3580	3100	172	91.5	89.6			
	0	93.2	99	101	107	117	3720	3220	172	93.3	91.2			
	10	95.0	98	100	107	117	3850	3350	172	92.0	92.5			
16000	-30	87.9	98	100	106	116	3210	2760	171	87.9	86.2			
	-20	89.7	98	100	105	116	3330	2880	171	89.7	87.9			
	-10	91.5	98	100	106	116	3460	2990	171	91.5	89.6			
	0	93.2	98	99	105	116	3600	3110	171	93.3	91.2			
	10	95.0	97	99	105	116	3720	3240	171	92.0	92.5			
15200	-30	87.9	95	97	103	113	2930	2520	170	87.9	86.2	107	2450	2120
	-20	89.7	95	97	103	113	3040	2620	170	89.7	87.9	107	2530	2190
	-10	91.5	95	96	103	113	3160	2730	170	91.5	89.6	107	2610	2260
	0	93.2	94	96	103	113	3270	2830	170	93.2	91.2	107	2690	2330
	10	95.0	94	96	103	113	3390	2950	170	92.0	92.5	107	2770	2400
14500	-30	87.9	92	94	100	111	2700	2320	169	87.9	86.2	105	2350	2040
	-20	89.7	92	94	100	111	2810	2410	169	89.7	87.9	105	2420	2100
	-10	91.5	92	94	100	111	2910	2520	169	91.4	89.6	105	2490	2170
	0	93.2	92	94	100	111	3020	2610	169	93.2	91.2	105	2570	2230
	10	95.0	92	93	100	111	3120	2700	169	92.0	92.5	105	2640	2300
13500	-30	87.9	89	90	97	109	2420	2060	168	87.9	86.2	101	2210	1910
	-20	89.7	89	90	97	109	2520	2150	168	89.7	87.9	101	2270	1970
	-10	91.5	88	90	97	109	2610	2230	168	91.4	89.6	101	2340	2030
	0	93.2	88	90	97	109	2700	2310	168	93.2	91.2	101	2400	2090
	10	95.0	88	89	97	109	2810	2390	168	92.0	92.5	101	2470	2150
12500	-30	87.9	89	89	94	107	2390	1960	167	87.9	86.2	98	2080	1790
	-20	89.7	89	89	94	107	2480	2040	167	89.6	87.9	98	2130	1850
	-10	91.5	89	89	94	107	2580	2130	167	91.4	89.6	98	2190	1900
	0	93.2	89	89	94	107	2670	2220	167	93.2	91.2	98	2250	1950
	10	95.0	89	89	93	106	2760	2290	167	92.0	92.5	98	2310	2010
11500	-30	87.9	90	90	95	109	2370	1950	165	87.8	86.2	94	1940	1680
	-20	89.7	90	90	95	109	2460	2030	165	89.6	87.9	94	2000	1730
	-10	91.5	90	90	95	109	2550	2110	165	91.4	89.6	94	2050	1770
	0	93.2	90	90	95	109	2630	2190	165	93.2	91.2	94	2100	1820
	10	95.0	89	89	95	108	2730	2270	165	92.0	92.5	94	2150	1870
10500	-30	87.9	91	91	96	111	2370	1960	164	87.8	86.2	90	1820	1580
	-20	89.7	91	91	96	111	2450	2040	164	89.6	87.9	90	1860	1620
	-10	91.5	91	91	96	111	2540	2110	164	91.4	89.6	90	1900	1660
	0	93.2	90	90	96	111	2620	2190	164	93.2	91.2	90	1950	1700
	10	95.0	90	90	96	111	2710	2260	164	92.0	92.5	90	2000	1740

Figure 7-16. Takeoff and Landing (Sheet 1 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7° **PRESSURE ALTITUDE 1000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS ON**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	89.3	99	101	107	117	3410	2950	170	89.1	87.5			
	-20	91.1	99	101	107	117	3550	3070	170	90.9	89.2			
	-10	92.9	99	100	107	117	3690	3200	170	92.7	90.9			
	0	94.7	98	100	107	117	3830	3320	170	93.3	92.6			
	10	96.1	98	100	107	117	3970	3460	170	92.0	92.5			
16000	-30	89.3	98	100	106	116	3290	2840	170	89.1	87.5			
	-20	91.1	98	100	106	116	3430	2970	170	90.9	89.2			
	-10	92.9	97	99	106	116	3560	3090	170	92.7	90.9			
	0	94.7	97	99	106	116	3690	3200	170	93.3	92.6			
	10	96.1	97	99	106	116	3830	3330	170	92.0	92.5			
15200	-30	89.3	95	97	103	113	3020	2600	169	89.1	87.5	107	2530	2190
	-20	91.1	95	96	103	113	3130	2700	169	90.9	89.2	107	2610	2260
	-10	92.9	94	96	103	113	3250	2820	169	92.7	90.9	107	2690	2340
	0	94.7	94	96	103	113	3360	2920	169	93.3	92.6	107	2770	2410
	10	96.1	94	96	103	113	3490	3030	169	92.0	92.5	107	2860	2490
14500	-30	89.3	92	94	100	111	2780	2400	168	89.1	87.5	105	2420	2100
	-20	91.1	92	94	100	111	2890	2490	168	90.9	89.2	105	2500	2170
	-10	92.9	92	93	100	111	3000	2600	168	92.7	90.9	105	2570	2230
	0	94.7	91	93	100	111	3110	2690	168	93.3	92.6	105	2650	2300
	10	96.1	91	93	100	111	3210	2800	168	92.0	92.5	105	2720	2370
13500	-30	89.3	89	90	97	109	2530	2120	166	89.1	87.5	101	2270	1970
	-20	91.1	89	90	97	109	2620	2200	166	90.9	89.2	101	2340	2030
	-10	92.9	89	89	97	109	2730	2300	166	92.7	90.9	101	2410	2090
	0	94.7	89	89	97	109	2830	2380	166	93.3	92.6	101	2470	2150
	10	96.1	88	89	97	109	2920	2470	166	92.0	92.5	101	2540	2220
12500	-30	89.3	90	90	94	107	2490	2050	165	89.0	87.5	98	2130	1850
	-20	91.1	89	89	94	107	2590	2130	165	90.9	89.2	98	2190	1900
	-10	92.9	89	89	94	107	2680	2230	165	92.7	90.9	98	2250	1960
	0	94.7	89	89	94	107	2780	2310	165	93.3	92.6	98	2310	2010
	10	96.1	89	89	94	107	2880	2400	165	92.0	92.5	98	2370	2070
11500	-30	89.3	90	90	95	109	2470	2040	164	89.0	87.5	94	2000	1730
	-20	91.1	90	90	95	109	2560	2120	164	90.8	89.2	94	2050	1770
	-10	92.9	90	90	95	109	2660	2200	164	92.6	90.9	94	2100	1820
	0	94.7	90	90	95	109	2750	2300	164	93.3	92.6	94	2160	1870
	10	96.1	90	90	95	109	2840	2380	164	92.0	92.5	94	2210	1920
10500	-30	89.3	91	91	97	111	2460	2040	163	89.0	87.5	90	1860	1620
	-20	91.1	91	91	97	111	2550	2120	163	90.8	89.2	90	1910	1660
	-10	92.9	91	91	97	111	2640	2200	163	92.6	90.9	90	1950	1700
	0	94.7	91	91	97	111	2740	2290	163	93.3	92.6	90	2000	1740
	10	96.1	90	90	97	111	2830	2370	163	92.0	92.5	90	2050	1790

Figure 7-16. Takeoff and Landing (Sheet 2 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7° **PRESSURE ALTITUDE 2000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS ON**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	90.6	99	101	107	117	3510	3040	169	90.3	88.8			
	-20	92.4	98	100	107	117	3650	3170	169	92.1	90.5			
	-10	94.3	98	100	107	117	3790	3290	169	93.9	92.3			
	0	96.1	98	100	107	117	3930	3420	169	93.3	93.7			
	10	96.1	98	99	107	117	4080	3560	169	92.0	92.4			
16000	-30	90.6	98	99	106	116	3390	2930	168	90.3	88.8			
	-20	92.4	97	99	106	116	3530	3060	168	92.1	90.5			
	-10	94.3	97	99	106	116	3670	3180	168	93.9	92.3			
	0	96.1	97	99	106	116	3790	3310	168	93.3	93.7			
	10	96.1	96	98	106	116	3940	3430	168	92.0	92.4			
15200	-30	90.6	94	96	103	113	3100	2680	167	90.3	88.8	107	2610	2260
	-20	92.4	94	96	103	113	3220	2800	167	92.1	90.5	107	2690	2340
	-10	94.3	94	96	103	113	3350	2900	167	93.9	92.3	107	2780	2410
	0	96.1	94	95	103	113	3470	3020	167	93.3	93.7	107	2860	2490
	10	96.1	93	95	103	113	3580	3120	167	92.0	92.4	107	2950	2570
14500	-30	90.6	92	94	100	111	2870	2470	166	90.3	88.8	105	2490	2160
	-20	92.4	91	93	100	111	2980	2580	166	92.1	90.5	105	2570	2240
	-10	94.3	91	93	100	111	3090	2680	166	93.9	92.3	105	2650	2310
	0	96.1	91	93	100	111	3190	2770	166	93.3	93.7	105	2730	2380
	10	96.1	91	93	100	111	3320	2880	166	92.0	92.4	105	2810	2450
13500	-30	90.6	89	90	97	109	2630	2190	165	90.3	88.8	101	2340	2030
	-20	92.4	89	89	97	109	2740	2270	165	92.1	90.5	101	2410	2090
	-10	94.3	89	89	97	109	2840	2370	165	93.9	92.3	101	2480	2160
	0	96.1	89	89	97	109	2960	2450	165	93.3	93.7	101	2550	2220
	10	96.1	89	89	97	109	3060	2540	165	92.0	92.4	101	2620	2290
12500	-30	90.6	90	90	95	108	2600	2150	163	90.2	88.8	98	2190	1900
	-20	92.4	90	90	95	108	2690	2240	163	92.1	90.5	98	2260	1960
	-10	94.3	90	90	95	108	2800	2330	163	93.9	92.3	98	2320	2020
	0	96.1	89	89	95	108	2910	2420	163	93.3	93.7	98	2380	2070
	10	96.1	89	89	95	108	3000	2510	163	92.0	92.4	98	2440	2130
11500	-30	90.6	91	91	96	110	2580	2130	162	90.2	88.8	94	2050	1770
	-20	92.4	90	90	96	110	2670	2220	162	92.0	90.5	94	2110	1830
	-10	94.3	90	90	96	110	2770	2310	162	93.9	92.3	94	2160	1880
	0	96.1	90	90	96	110	2880	2400	162	93.3	93.7	94	2220	1930
	10	96.1	90	90	96	110	2970	2480	162	92.0	92.4	94	2270	1980
10500	-30	90.6	91	91	98	112	2560	2130	161	90.2	88.8	90	1910	1660
	-20	92.4	91	91	97	112	2660	2220	161	92.0	90.5	90	1960	1700
	-10	94.3	91	91	98	112	2760	2310	161	93.9	92.3	90	2010	1750
	0	96.1	91	91	98	112	2850	2400	161	93.3	93.7	90	2060	1790
	10	96.1	91	91	97	112	2950	2480	161	92.0	92.4	90	2110	1830

Figure 7-16. Takeoff and Landing (Sheet 3 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7° **PRESSURE ALTITUDE 3000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS ON**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	92.0	98	100	107	117	3620	3130	167	91.8	90.0			
	-20	93.8	98	100	107	117	3770	3270	167	93.6	91.8			
	-10	95.7	98	100	107	117	3910	3410	167	94.4	93.6			
	0	97.1	97	99	107	117	4070	3550	167	93.3	93.6			
	10	96.1	98	100	107	117	4320	3770	167	92.0	92.4			
16000	-30	92.0	97	99	106	116	3490	3030	167	91.8	90.0			
	-20	93.8	97	99	106	116	3640	3160	167	93.6	91.8			
	-10	95.7	97	98	106	116	3780	3280	167	94.4	93.6			
	0	97.1	96	98	106	116	3930	3420	167	93.3	93.6			
	10	96.1	97	98	105	116	4160	3630	167	92.0	92.4			
15200	-30	92.0	94	96	103	113	3200	2770	166	91.8	90.0	107	2690	2340
	-20	93.8	94	96	103	113	3330	2890	166	93.6	91.8	107	2780	2420
	-10	95.7	94	95	103	113	3460	3000	166	94.4	93.6	107	2870	2500
	0	97.1	93	95	103	113	3580	3120	166	93.3	93.6	107	2960	2580
	10	96.1	94	95	103	113	3780	3290	166	92.0	92.4	107	3050	2660
14500	-30	92.0	91	93	100	112	2950	2550	165	91.8	90.0	105	2570	2230
	-20	93.8	91	93	100	112	3070	2660	165	93.6	91.8	105	2650	2310
	-10	95.7	91	93	100	112	3180	2760	165	94.4	93.6	105	2740	2380
	0	97.1	91	93	100	112	3310	2880	165	93.3	93.6	105	2820	2460
	10	96.1	91	93	100	111	3480	3040	165	92.0	92.4	105	2900	2530
13500	-30	92.0	89	89	97	109	2740	2270	164	91.8	90.0	101	2410	2090
	-20	93.8	89	89	97	109	2850	2370	164	93.6	91.8	101	2480	2160
	-10	95.7	89	89	97	109	2970	2460	164	94.4	93.6	101	2560	2230
	0	97.1	89	89	97	109	3060	2550	164	93.3	93.6	101	2630	2290
	10	96.1	87	89	97	109	3110	2680	164	92.0	92.4	101	2700	2360
12500	-30	92.0	90	90	95	108	2700	2240	162	91.8	90.0	98	2260	1960
	-20	93.8	90	90	95	108	2810	2330	162	93.6	91.8	98	2320	2020
	-10	95.7	90	90	95	108	2920	2440	162	94.4	93.6	98	2390	2080
	0	97.1	89	89	95	108	3020	2520	162	93.3	93.6	98	2450	2140
	10	96.1	88	88	93	106	3050	2550	162	92.0	92.4	98	2520	2200
11500	-30	92.0	91	91	96	110	2680	2230	161	91.8	90.0	94	2110	1830
	-20	93.8	91	91	96	110	2780	2320	161	93.6	91.8	94	2160	1880
	-10	95.7	90	90	96	110	2890	2410	161	94.4	93.6	94	2220	1930
	0	97.1	90	90	96	110	2980	2490	161	93.3	93.6	94	2280	1990
	10	96.1	89	89	94	108	3020	2530	161	92.0	92.4	94	2340	2040
10500	-30	92.0	92	92	98	113	2670	2230	159	91.8	90.0	90	1960	1710
	-20	93.8	91	91	98	113	2770	2320	159	93.5	91.8	90	2010	1750
	-10	95.7	91	91	98	113	2870	2410	159	94.4	93.6	90	2060	1800
	0	97.1	91	91	98	112	2960	2490	159	93.3	93.6	90	2110	1840
	10	96.1	89	89	96	110	2990	2520	159	92.0	92.4	90	2160	1890

Figure 7-16. Takeoff and Landing (Sheet 4 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 4000 FEET
ANTI-ICE SYSTEMS ON

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	93.4	98	100	107	117	3740	3240	166	93.4	91.3			
	-20	95.3	97	99	107	117	3890	3380	166	95.1	93.1			
	-10	97.1	97	99	107	117	4040	3530	166	94.4	94.7			
	0	97.1	97	99	107	117	4250	3710	166	93.3	93.6			
	10	96.1	98	100	107	116	4610	4030	166	92.0	92.4			
16000	-30	93.4	97	99	106	116	3610	3130	166	93.4	91.3			
	-20	95.3	96	98	106	116	3750	3260	166	95.1	93.1			
	-10	97.1	96	98	106	116	3900	3400	166	94.4	94.7			
	0	97.1	96	98	106	116	4090	3570	166	93.3	93.6			
	10	96.1	97	99	105	116	4440	3870	166	92.0	92.4			
15200	-30	93.4	94	96	103	114	3290	2870	165	93.4	91.3	107	2780	2420
	-20	95.3	93	95	103	113	3430	2980	165	95.1	93.1	107	2870	2500
	-10	97.1	93	95	103	113	3560	3100	165	94.4	94.7	107	2970	2580
	0	97.1	93	95	103	113	3740	3260	165	93.3	93.6	107	3060	2670
	10	96.1	94	96	103	113	4010	3500	165	92.0	92.4	107	3160	2750
14500	-30	93.4	91	93	100	112	3040	2630	163	93.3	91.3	105	2650	2310
	-20	95.3	91	93	100	112	3170	2750	163	95.1	93.1	105	2740	2390
	-10	97.1	91	92	100	112	3280	2850	163	94.4	94.7	105	2830	2460
	0	97.1	91	92	100	111	3450	2990	163	93.3	93.6	105	2910	2540
	10	96.1	91	93	100	111	3690	3210	163	92.0	92.4	105	3000	2620
13500	-30	93.4	90	90	97	109	2870	2370	162	93.3	91.3	101	2480	2160
	-20	95.3	89	89	97	109	2980	2470	162	95.1	93.1	101	2560	2230
	-10	97.1	89	89	97	109	3100	2580	162	94.4	94.7	101	2640	2300
	0	97.1	88	89	97	109	3170	2640	162	93.3	93.6	101	2710	2370
	10	96.1	87	89	96	108	3260	2840	162	92.0	92.4	101	2790	2440
12500	-30	93.4	90	90	96	109	2820	2340	161	93.3	91.3	98	2320	2020
	-20	95.3	90	90	96	109	2930	2450	161	95.1	93.1	98	2390	2080
	-10	97.1	90	90	95	109	3040	2540	161	94.4	94.7	98	2460	2140
	0	97.1	89	89	94	108	3110	2600	161	93.3	93.6	98	2530	2210
	10	96.1	86	86	93	105	3090	2580	161	92.0	92.4	98	2590	2270
11500	-30	93.4	91	91	97	111	2800	2330	159	93.3	91.3	94	2170	1880
	-20	95.3	91	91	97	111	2900	2420	159	95.1	93.1	94	2230	1940
	-10	97.1	91	91	97	111	3000	2520	159	94.4	94.7	94	2290	1990
	0	97.1	90	90	96	110	3070	2580	159	93.3	93.6	94	2350	2050
	10	96.1	87	87	92	106	3040	2540	159	92.0	92.4	94	2410	2100
10500	-30	93.4	92	92	99	113	2780	2330	158	93.3	91.3	90	2010	1750
	-20	95.3	92	92	99	113	2890	2420	158	95.1	93.1	90	2070	1800
	-10	97.1	91	91	98	113	2990	2520	158	94.4	94.7	90	2120	1850
	0	97.1	90	90	97	112	3050	2560	158	93.3	93.6	90	2170	1890
	10	96.1	88	88	94	108	3000	2530	158	92.0	92.4	90	2230	1940

Figure 7-16. Takeoff and Landing (Sheet 5 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7° — **PRESSURE ALTITUDE 5000 FEET**
LANDING - FLAPS FULL — **ANTI-ICE SYSTEMS ON**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	95.3	97	99	107	117	3830	3340	165	94.9	92.6			
	-20	97.2	97	99	107	117	4000	3490	165	95.4	94.4			
	-10	98.0	97	99	107	117	4220	3690	165	94.4	94.7			
	0	97.1	98	99	107	117	4520	3960	165	93.3	93.6			
	10	96.1	99	100	106	116	4950	4340	165	91.9	92.3			
16000	-30	95.3	96	98	106	116	3700	3220	164	94.9	92.6			
	-20	97.2	96	98	106	116	3860	3360	164	95.4	94.4			
	-10	98.0	96	98	106	116	4070	3560	164	94.4	94.7			
	0	97.1	96	98	105	116	4360	3820	164	93.3	93.6			
	10	96.1	97	99	105	115	4770	4180	164	91.9	92.3			
15200	-30	95.3	93	95	103	114	3390	2950	163	94.9	92.6	107	2870	2500
	-20	97.2	93	95	103	114	3540	3070	163	95.4	94.4	107	2970	2590
	-10	98.0	93	95	103	113	3710	3240	163	94.4	94.7	107	3070	2670
	0	97.1	93	95	103	113	3960	3460	163	93.3	93.6	107	3170	2760
	10	96.1	94	96	103	113	4320	3770	163	92.0	92.3	107	3280	2860
14500	-30	95.3	91	92	100	112	3120	2710	162	94.9	92.6	105	2740	2380
	-20	97.2	90	92	100	112	3260	2830	162	95.4	94.4	105	2830	2470
	-10	98.0	90	92	100	112	3420	2980	162	94.4	94.7	105	2920	2550
	0	97.1	91	93	100	111	3640	3180	162	93.3	93.6	105	3010	2630
	10	96.1	92	93	100	110	3940	3450	162	92.0	92.3	105	3110	2710
13500	-30	95.3	90	90	97	109	2990	2490	160	94.8	92.6	101	2560	2230
	-20	97.2	90	90	97	109	3110	2590	160	95.4	94.4	101	2640	2300
	-10	98.0	89	89	97	109	3180	2660	160	94.4	94.7	101	2720	2380
	0	97.1	87	89	97	108	3210	2810	160	93.3	93.6	101	2800	2450
	10	96.1	88	89	96	108	3480	3030	160	92.0	92.3	101	2880	2520
12500	-30	95.3	91	91	96	110	2960	2460	159	94.8	92.6	98	2390	2080
	-20	97.2	90	90	96	109	3060	2560	159	95.4	94.4	98	2460	2150
	-10	98.0	89	89	95	108	3130	2620	159	94.4	94.7	98	2530	2210
	0	97.1	87	87	93	106	3140	2630	159	93.3	93.6	98	2600	2280
	10	96.1	84	85	93	105	3090	2660	159	92.0	92.3	98	2680	2340
11500	-30	95.3	91	91	98	112	2920	2450	158	94.8	92.6	94	2230	1940
	-20	97.2	91	91	97	111	3030	2540	158	95.4	94.4	94	2290	2000
	-10	98.0	90	90	96	110	3090	2590	158	94.4	94.7	94	2350	2050
	0	97.1	88	88	94	108	3100	2600	158	93.3	93.6	94	2420	2110
	10	96.1	85	85	90	103	3040	2540	158	92.0	92.3	94	2480	2170
10500	-30	95.3	92	92	99	114	2910	2450	157	94.8	92.6	90	2070	1800
	-20	97.2	92	92	99	114	3020	2540	157	95.4	94.4	90	2120	1850
	-10	98.0	91	91	98	112	3070	2590	157	94.4	94.7	90	2180	1900
	0	97.1	89	89	95	110	3060	2590	157	93.3	93.6	90	2240	1950
	10	96.1	85	85	91	105	2990	2520	157	92.0	92.3	90	2290	2000

Figure 7-16 Takeoff and Landing (Sheet 6 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7° **PRESSURE ALTITUDE 6000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS ON**

WT LBS	AMB. TEMP DEG C	TAKEOFF FAN PERCENT RPM	TAKEOFF V1 = KIAS ZERO WIND	TAKEOFF V1 = KIAS 20 KT WIND	TAKEOFF VR KIAS	TAKEOFF V2 KIAS	TAKEOFF FIELD LENGTH - FT ZERO WIND	TAKEOFF FIELD LENGTH - FT 20 KT WIND	CLIMB VENR KIAS	CLIMB S.E. FAN PERCENT RPM	CLIMB M.E. FAN PERCENT RPM	LANDING VREF KIAS	LANDING DISTANCE FEET ZERO WIND	LANDING DISTANCE FEET 20 KT WIND
16300	-30	97.3	97	99	107	117	3940	3430	164	96.3	94.7			
	-20	98.7	97	99	107	117	4130	3610	164	95.4	95.7			
	-10	98.0	97	99	107	117	4450	3900	164	94.4	94.6			
	0	97.1	98	100	107	116	4840	4230	164	93.3	93.5			
	10	96.1	99	101	106	116	5340	4670	164	91.9	92.3			
16000	-30	97.3	96	98	106	116	3820	3330	163	96.3	94.7			
	-20	98.7	96	97	106	116	3990	3480	163	95.4	95.7			
	-10	98.0	96	98	106	116	4290	3760	163	94.4	94.6			
	0	97.1	97	99	105	115	4660	4080	163	93.3	93.5			
	10	96.1	98	100	105	115	5140	4500	163	91.9	92.3			
15200	-30	97.3	93	95	103	114	3490	3040	162	96.3	94.7	107	2970	2590
	-20	98.7	93	95	103	114	3640	3180	162	95.4	95.7	107	3080	2680
	-10	98.0	93	95	103	113	3910	3410	162	94.4	94.6	107	3180	2770
	0	97.1	94	96	103	113	4210	3690	162	93.3	93.5	107	3290	2870
	10	96.1	95	97	103	113	4640	4060	162	91.9	92.3	107	3400	2960
14500	-30	97.3	90	92	100	112	3210	2800	161	96.3	94.7	105	2830	2470
	-20	98.7	90	92	100	112	3360	2930	161	95.4	95.7	105	2930	2550
	-10	98.0	90	92	100	111	3600	3140	161	94.4	94.6	105	3020	2640
	0	97.1	91	93	100	111	3860	3380	161	93.3	93.5	105	3120	2720
	10	96.1	92	94	100	110	4230	3700	161	92.0	92.3	105	3220	2810
13500	-30	97.3	91	91	97	109	3140	2620	159	96.3	94.7	101	2640	2300
	-20	98.7	90	90	97	109	3250	2710	159	95.4	95.7	101	2730	2380
	-10	98.0	88	88	97	109	3260	2770	159	94.4	94.6	101	2810	2460
	0	97.1	87	89	96	108	3410	2980	159	93.3	93.5	101	2900	2530
	10	96.1	88	90	96	107	3700	3240	159	92.0	92.3	101	2980	2610
12500	-30	97.3	91	91	97	110	3100	2590	158	96.3	94.7	98	2460	2150
	-20	98.7	91	91	96	110	3200	2680	158	95.4	95.7	98	2540	2210
	-10	98.0	88	88	94	107	3190	2680	158	94.4	94.6	98	2610	2280
	0	97.1	86	86	93	105	3170	2660	158	93.3	93.5	98	2690	2350
	10	96.1	84	86	93	104	3250	2830	158	92.0	92.3	98	2760	2420
11500	-30	97.3	92	92	98	113	3060	2560	156	96.3	94.7	94	2290	2000
	-20	98.7	91	91	98	112	3160	2660	156	95.4	95.7	94	2360	2060
	-10	98.0	89	89	95	109	3160	2640	156	94.4	94.6	94	2430	2120
	0	97.1	86	86	92	105	3120	2610	156	93.3	93.5	94	2490	2180
	10	96.1	83	83	88	101	3040	2540	156	92.0	92.3	94	2560	2240
10500	-30	97.3	93	93	100	115	3050	2560	155	96.3	94.7	90	2130	1850
	-20	98.7	92	92	100	114	3140	2640	155	95.4	95.7	90	2180	1900
	-10	98.0	90	90	97	111	3120	2630	155	94.4	94.6	90	2240	1960
	0	97.1	87	87	93	107	3070	2590	155	93.3	93.5	90	2300	2010
	10	96.1	83	83	89	102	2990	2520	155	92.0	92.3	90	2360	2060

Figure 7-16. Takeoff and Landing (Sheet 7 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 7° **PRESSURE ALTITUDE 7000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS ON**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	99.0	97	99	107	117	4150	3620	163	96.3	96.6			
	-20	98.7	97	99	107	117	4430	3870	163	95.3	95.6			
	-10	98.0	98	100	107	116	4790	4200	163	94.4	94.6			
	0	97.1	98	100	106	116	5200	4560	163	93.3	93.5			
	10	96.1	99	101	106	116	5740	5030	163	91.9	92.3			
16000	-30	99.0	96	98	106	116	4000	3490	162	96.3	96.6			
	-20	98.7	96	98	106	116	4270	3740	162	95.4	95.6			
	-10	98.0	97	98	105	116	4620	4040	162	94.4	94.6			
	0	97.1	97	99	105	115	5010	4380	162	93.3	93.5			
	10	96.1	98	100	105	115	5530	4850	162	91.9	92.3			
15200	-30	99.0	93	95	103	114	3670	3190	161	96.3	96.6	107	3080	2680
	-20	98.7	93	95	103	113	3890	3390	161	95.4	95.6	107	3190	2780
	-10	98.0	94	95	103	113	4180	3650	161	94.4	94.6	107	3300	2870
	0	97.1	94	96	103	113	4520	3970	161	93.3	93.5	107	3410	2970
	10	96.1	95	97	103	113	4990	4370	161	91.9	92.3	107	3530	3080
14500	-30	99.0	90	92	100	112	3380	2930	160	96.3	96.6	105	2930	2550
	-20	98.7	90	92	100	111	3570	3120	160	95.4	95.6	105	3030	2640
	-10	98.0	91	93	100	111	3830	3350	160	94.4	94.6	105	3130	2730
	0	97.1	92	93	100	110	4130	3620	160	93.3	93.5	105	3230	2820
	10	96.1	93	94	100	110	4550	3980	160	91.9	92.3	105	3340	2920
13500	-30	99.0	90	90	97	109	3210	2680	158	96.3	96.6	101	2730	2380
	-20	98.7	88	88	97	109	3270	2760	158	95.4	95.6	101	2820	2460
	-10	98.0	87	89	96	108	3390	2960	158	94.4	94.6	101	2900	2540
	0	97.1	88	89	96	107	3640	3180	158	93.3	93.5	101	2990	2620
	10	96.1	89	90	96	107	3960	3460	158	92.0	92.3	101	3090	2700
12500	-30	99.0	90	90	96	109	3170	2640	156	96.4	96.6	98	2540	2220
	-20	98.7	89	89	94	107	3210	2690	156	95.4	95.6	98	2620	2290
	-10	98.0	86	86	93	105	3200	2680	156	94.4	94.6	98	2700	2360
	0	97.1	83	85	93	105	3190	2780	156	93.3	93.5	98	2770	2430
	10	96.1	84	86	92	104	3460	3020	156	92.0	92.3	98	2850	2500
11500	-30	99.0	91	91	97	111	3120	2620	155	96.4	96.6	94	2360	2060
	-20	98.7	89	89	95	109	3170	2660	155	95.4	95.6	94	2430	2120
	-10	98.0	87	87	92	106	3160	2640	155	94.4	94.6	94	2500	2190
	0	97.1	84	84	89	103	3120	2620	155	93.3	93.5	94	2570	2250
	10	96.1	81	82	88	101	3050	2620	155	92.0	92.3	94	2640	2310
10500	-30	99.0	92	92	99	114	3110	2620	154	96.4	96.6	90	2190	1900
	-20	98.7	90	90	97	111	3140	2640	154	95.4	95.6	90	2250	1960
	-10	98.0	87	87	94	108	3110	2620	154	94.4	94.6	90	2310	2020
	0	97.1	85	85	91	105	3070	2590	154	93.3	93.5	90	2370	2070
	10	96.1	81	81	86	100	2990	2520	154	92.0	92.3	90	2430	2130

Figure 7-16. Takeoff and Landing (Sheet 8 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE SEA LEVEL
ANTI-ICE SYSTEMS OFF

WT	AMB. TEMP	TAKEOFF FAN	TAKEOFF V1 = KIAS		TAKEOFF VR	TAKEOFF V2	TAKEOFF FIELD LENGTH - FT		CLIMB VENR	CLIMB S.E. FAN	CLIMB M.E. FAN	LANDING VREF	LANDING DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	87.9	95	96	102	112	2700	2320	172	87.9	86.2			
	-20	89.7	94	96	102	112	2810	2410	172	89.7	87.9			
	-10	91.5	94	96	102	112	2910	2510	172	91.5	89.6			
	0	93.2	94	96	102	112	3020	2610	172	93.3	91.2			
	10	95.0	94	96	102	112	3130	2710	172	95.0	92.9			
	20	96.7	94	96	102	112	3260	2830	172	94.0	92.8			
	30	96.7	95	96	102	112	3510	3050	172	92.5	91.3			
	40	95.3	96	98	102	112	3940	3420	172	90.9	89.8			
16000	-30	87.9	94	95	101	111	2610	2240	171	87.9	86.2			
	-20	89.7	93	95	101	111	2710	2330	171	89.7	87.9			
	-10	91.5	93	95	101	111	2810	2420	171	91.5	89.6			
	0	93.2	93	95	101	111	2920	2520	171	93.3	91.2			
	10	95.0	93	94	101	111	3020	2620	171	95.0	92.9			
	20	96.7	93	94	101	111	3150	2730	171	94.0	92.8			
	30	96.7	93	95	101	111	3390	2940	171	92.5	91.3			
	40	95.3	95	97	101	111	3800	3300	171	90.9	89.8			
15200	-30	87.9	90	92	98	109	2380	2040	170	87.9	86.2	107	2450	2120
	-20	89.7	90	92	98	109	2470	2130	170	89.7	87.9	107	2530	2190
	-10	91.5	90	92	98	109	2570	2210	170	91.5	89.6	107	2610	2260
	0	93.2	90	92	98	109	2660	2290	170	93.2	91.2	107	2690	2330
	10	95.0	90	91	98	109	2750	2380	170	95.0	92.9	107	2770	2400
	20	96.7	90	91	98	109	2870	2480	170	94.0	92.8	107	2840	2480
	30	96.7	90	92	98	109	3070	2670	170	92.5	91.3	107	2930	2550
	40	95.3	92	94	98	109	3440	2980	170	90.9	89.8	107	3010	2620
14500	-30	87.9	88	90	96	107	2220	1880	169	87.9	86.2	105	2350	2040
	-20	89.7	88	89	96	107	2300	1960	169	89.7	87.9	105	2420	2100
	-10	91.5	88	89	96	107	2390	2040	169	91.4	89.6	105	2490	2170
	0	93.2	88	89	96	107	2480	2110	169	93.2	91.2	105	2570	2230
	10	95.0	88	89	96	107	2570	2190	169	95.0	92.9	105	2640	2300
	20	96.7	87	89	96	107	2650	2290	169	94.0	92.8	105	2710	2360
	30	96.7	88	89	96	106	2820	2440	169	92.5	91.3	105	2790	2430
	40	95.3	89	91	96	106	3150	2720	169	90.9	89.8	105	2860	2500
13500	-30	87.9	89	89	92	105	2190	1800	168	87.9	86.2	101	2210	1910
	-20	89.7	89	89	92	105	2280	1880	168	89.7	87.9	101	2270	1970
	-10	91.5	88	88	92	105	2370	1960	168	91.4	89.6	101	2340	2030
	0	93.2	88	88	92	105	2450	2030	168	93.2	91.2	101	2400	2090
	10	95.0	88	88	92	105	2540	2110	168	95.0	92.9	101	2470	2150
	20	96.7	87	87	92	105	2600	2160	168	94.0	92.8	101	2530	2210
	30	96.7	85	85	92	104	2580	2160	168	92.5	91.3	101	2600	2270
	40	95.3	85	86	92	103	2760	2380	168	90.9	89.8	101	2670	2330
12500	-30	87.9	89	89	90	103	2180	1800	167	87.9	86.2	98	2080	1790
	-20	89.7	89	89	90	103	2270	1880	167	89.6	87.9	98	2130	1850
	-10	91.5	89	89	90	103	2350	1950	167	91.4	89.6	98	2190	1900
	0	93.2	89	89	90	103	2440	2020	167	93.2	91.2	98	2250	1950
	10	95.0	89	89	90	103	2520	2100	167	95.0	92.9	98	2310	2010
	20	96.7	88	88	89	102	2580	2150	167	94.0	92.8	98	2360	2060
	30	96.7	85	85	89	101	2550	2120	167	92.5	91.3	98	2420	2110
	40	95.3	81	82	88	100	2420	2090	167	90.9	89.8	98	2480	2170
11500	-30	87.9	90	90	91	105	2190	1810	165	87.8	86.2	94	1940	1680
	-20	89.7	90	90	91	105	2270	1890	165	89.6	87.9	94	2000	1730
	-10	91.5	90	90	91	105	2360	1960	165	91.4	89.6	94	2050	1770
	0	93.2	89	89	91	105	2440	2030	165	93.2	91.2	94	2100	1820
	10	95.0	89	89	91	105	2520	2110	165	95.0	92.9	94	2150	1870
	20	96.7	89	89	90	104	2580	2150	165	94.0	92.8	94	2200	1920
	30	96.7	86	86	87	101	2530	2120	165	92.5	91.3	94	2250	1960
	40	95.3	81	81	85	97	2380	1980	165	90.9	89.8	94	2310	2010
10500	-30	87.9	91	91	92	107	2220	1860	164	87.8	86.2	90	1820	1580
	-20	89.7	91	91	92	107	2300	1930	164	89.6	87.9	90	1860	1620
	-10	91.5	91	91	93	107	2390	2000	164	91.4	89.6	90	1900	1660
	0	93.2	90	90	92	107	2470	2070	164	93.2	91.2	90	1950	1700
	10	95.0	90	90	92	107	2550	2140	164	95.0	92.9	90	2000	1740
	20	96.7	89	89	92	106	2600	2180	164	94.1	92.8	90	2040	1780
	30	96.7	87	87	89	103	2540	2130	164	92.6	91.3	90	2090	1820
	40	95.3	82	82	83	97	2370	1980	164	90.9	89.8	90	2130	1860

Figure 7-17. Takeoff and Landing (Sheet 1 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15° **PRESSURE ALTITUDE 1000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS OFF**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	89.3	94	96	102	112	2780	2390	170	89.1	87.5			
	-20	91.1	94	96	102	112	2890	2490	170	90.9	89.2			
	-10	92.9	94	96	102	112	2990	2590	170	92.7	90.9			
	0	94.7	94	95	102	112	3100	2690	170	94.5	92.6			
	10	96.4	93	95	102	112	3220	2790	170	95.3	94.2			
	20	97.8	94	96	102	112	3420	2970	170	94.0	92.8			
	30	96.7	95	97	102	112	3760	3270	170	92.5	91.3			
	40	95.3	97	98	102	112	4230	3680	170	90.9	89.8			
16000	-30	89.3	93	95	101	111	2680	2310	170	89.1	87.5			
	-20	91.1	93	95	101	111	2790	2400	170	90.9	89.2			
	-10	92.9	93	94	101	111	2890	2500	170	92.7	90.9			
	0	94.7	92	94	101	111	3000	2600	170	94.5	92.6			
	10	96.4	92	94	101	111	3110	2700	170	95.3	94.2			
	20	97.8	93	94	101	111	3300	2860	170	94.0	92.8			
	30	96.7	94	96	101	111	3620	3150	170	92.5	91.3			
	40	95.3	96	97	101	111	4080	3540	170	90.9	89.8			
15200	-30	89.3	90	92	98	109	2450	2100	169	89.1	87.5	107	2530	2190
	-20	91.1	90	92	98	109	2550	2190	169	90.9	89.2	107	2610	2260
	-10	92.9	90	91	98	109	2640	2280	169	92.7	90.9	107	2690	2340
	0	94.7	89	91	98	109	2740	2370	169	94.5	92.6	107	2770	2410
	10	96.4	89	91	98	109	2830	2460	169	95.3	94.2	107	2860	2490
	20	97.8	90	91	98	109	3000	2600	169	94.0	92.8	107	2940	2560
	30	96.7	91	92	98	109	3280	2850	169	92.5	91.3	107	3030	2640
	40	95.3	92	94	98	109	3680	3200	169	90.9	89.8	107	3110	2710
14500	-30	89.3	88	89	96	107	2310	1940	168	89.1	87.5	105	2420	2100
	-20	91.1	88	89	96	107	2400	2020	168	90.9	89.2	105	2500	2170
	-10	92.9	88	89	96	107	2500	2100	168	92.7	90.9	105	2570	2230
	0	94.7	88	89	96	107	2590	2180	168	94.5	92.6	105	2650	2300
	10	96.4	88	88	96	107	2690	2260	168	95.3	94.2	105	2720	2370
	20	97.8	87	89	96	107	2760	2390	168	94.0	92.8	105	2800	2440
	30	96.7	88	90	96	106	3010	2610	168	92.5	91.3	105	2880	2510
	40	95.3	90	91	96	106	3370	2920	168	90.9	89.8	105	2960	2580
13500	-30	89.3	89	89	92	105	2290	1890	166	89.1	87.5	101	2270	1970
	-20	91.1	89	89	92	105	2380	1970	166	90.9	89.2	101	2340	2030
	-10	92.9	89	89	92	105	2470	2050	166	92.7	90.9	101	2410	2090
	0	94.7	89	89	92	105	2560	2130	166	94.5	92.6	101	2470	2150
	10	96.4	88	88	92	105	2650	2210	166	95.3	94.2	101	2540	2220
	20	97.8	87	87	92	104	2660	2220	166	94.0	92.8	101	2610	2280
	30	96.7	84	86	92	103	2650	2300	166	92.5	91.3	101	2680	2340
	40	95.3	85	87	92	103	2950	2550	166	90.9	89.8	101	2750	2400
12500	-30	89.3	90	90	90	104	2280	1880	165	89.0	87.5	98	2130	1850
	-20	91.1	89	89	90	104	2370	1960	165	90.9	89.2	98	2190	1900
	-10	92.9	89	89	90	104	2450	2040	165	92.7	90.9	98	2250	1960
	0	94.7	89	89	90	104	2540	2120	165	94.5	92.6	98	2310	2010
	10	96.4	89	89	90	103	2630	2200	165	95.3	94.2	98	2370	2070
	20	97.8	87	87	89	102	2640	2200	165	94.0	92.8	98	2430	2120
	30	96.7	84	84	89	101	2550	2120	165	92.5	91.3	98	2490	2180
	40	95.3	81	83	88	100	2570	2220	165	90.9	89.8	98	2560	2240
11500	-30	89.3	90	90	92	105	2280	1900	164	89.0	87.5	94	2000	1730
	-20	91.1	90	90	92	105	2370	1970	164	90.8	89.2	94	2050	1770
	-10	92.9	90	90	92	105	2460	2050	164	92.6	90.9	94	2100	1820
	0	94.7	90	90	92	105	2550	2130	164	94.5	92.6	94	2160	1870
	10	96.4	90	90	91	105	2630	2200	164	95.3	94.2	94	2210	1920
	20	97.8	88	88	89	103	2630	2200	164	94.0	92.8	94	2260	1970
	30	96.7	84	84	85	99	2530	2110	164	92.5	91.3	94	2320	2020
	40	95.3	79	79	85	97	2380	1980	164	90.9	89.8	94	2370	2070
10500	-30	89.3	91	91	93	108	2320	1940	163	89.0	87.5	90	1860	1620
	-20	91.1	91	91	93	108	2400	2010	163	90.8	89.2	90	1910	1660
	-10	92.9	91	91	93	108	2490	2090	163	92.6	90.9	90	1950	1700
	0	94.7	91	91	93	108	2580	2160	163	94.4	92.6	90	2000	1740
	10	96.4	90	90	93	108	2660	2240	163	95.3	94.2	90	2050	1790
	20	97.8	89	89	91	105	2650	2230	163	94.0	92.8	90	2100	1830
	30	96.7	85	85	86	100	2530	2120	163	92.5	91.3	90	2140	1870
	40	95.3	80	80	81	94	2360	1970	163	90.9	89.8	90	2190	1910

Figure 7-17. Takeoff and Landing (Sheet 2 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 2000 FEET
ANTI-ICE SYSTEMS OFF

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	90.6	94	96	102	112	2850	2460	169	90.3	88.8			
	-20	92.4	94	95	102	112	2970	2570	169	92.1	90.5			
	-10	94.3	93	95	102	112	3080	2670	169	93.9	92.3			
	0	96.1	93	95	102	112	3190	2770	169	95.7	94.0			
	10	97.9	93	95	102	112	3310	2880	169	95.3	94.2			
	20	97.8	94	96	102	112	3610	3140	169	94.0	92.8			
	30	96.7	95	97	102	112	4030	3510	169	92.5	91.3			
	40	95.3	97	98	102	112	4550	3960	169	90.9	89.7			
16000	-30	90.6	93	95	101	111	2760	2380	168	90.3	88.8			
	-20	92.4	92	94	101	111	2870	2480	168	92.1	90.5			
	-10	94.3	92	94	101	111	2980	2580	168	93.9	92.3			
	0	96.1	92	94	101	111	3080	2670	168	95.7	94.0			
	10	97.9	92	94	101	111	3200	2780	168	95.3	94.2			
	20	97.8	93	95	101	111	3490	3030	168	94.0	92.8			
	30	96.7	94	96	101	111	3880	3380	168	92.5	91.3			
	40	95.3	96	97	101	111	4380	3810	168	90.9	89.7			
15200	-30	90.6	90	92	98	109	2520	2170	167	90.3	88.8	107	2610	2260
	-20	92.4	90	91	98	109	2620	2260	167	92.1	90.5	107	2690	2340
	-10	94.3	89	91	98	109	2720	2350	167	93.9	92.3	107	2780	2410
	0	96.1	89	91	98	109	2810	2440	167	95.7	94.0	107	2860	2490
	10	97.9	89	91	98	109	2920	2530	167	95.3	94.2	107	2950	2570
	20	97.8	90	91	98	109	3160	2750	167	94.0	92.8	107	3040	2650
	30	96.7	91	93	98	109	3510	3060	167	92.5	91.3	107	3130	2730
	40	95.3	93	94	98	109	3950	3440	167	90.9	89.7	107	3220	2810
14500	-30	90.6	89	89	96	107	2410	2000	166	90.3	88.8	105	2490	2160
	-20	92.4	89	89	96	107	2510	2080	166	92.1	90.5	105	2570	2240
	-10	94.3	88	89	96	107	2610	2170	166	93.9	92.3	105	2650	2310
	0	96.1	88	88	96	107	2710	2250	166	95.7	94.0	105	2730	2380
	10	97.9	88	88	96	107	2810	2330	166	95.3	94.2	105	2810	2450
	20	97.8	87	89	96	107	2910	2520	166	94.0	92.8	105	2890	2520
	30	96.7	89	90	96	106	3210	2790	166	92.5	91.3	105	2970	2600
	40	95.3	90	92	96	106	3610	3130	166	90.9	89.7	105	3060	2670
13500	-30	90.6	89	89	92	105	2390	1970	165	90.3	88.8	101	2340	2030
	-20	92.4	89	89	92	105	2480	2060	165	92.1	90.5	101	2410	2090
	-10	94.3	89	89	92	105	2580	2140	165	93.9	92.3	101	2480	2160
	0	96.1	89	89	92	105	2680	2230	165	95.7	94.0	101	2550	2220
	10	97.9	89	89	92	105	2770	2310	165	95.3	94.2	101	2620	2290
	20	97.8	85	85	92	104	2700	2250	165	94.0	92.8	101	2690	2350
	30	96.7	84	86	92	103	2820	2440	165	92.5	91.3	101	2770	2420
	40	95.3	86	87	92	103	3150	2730	165	90.9	89.7	101	2840	2480
12500	-30	90.6	90	90	91	104	2380	1970	163	90.2	88.8	98	2190	1900
	-20	92.4	90	90	91	104	2470	2050	163	92.1	90.5	98	2260	1960
	-10	94.3	89	89	91	104	2560	2130	163	93.9	92.3	98	2320	2020
	0	96.1	89	89	91	104	2660	2220	163	95.7	94.0	98	2380	2070
	10	97.9	89	89	91	104	2750	2300	163	95.3	94.2	98	2440	2130
	20	97.8	86	86	89	101	2670	2230	163	94.0	92.8	98	2510	2190
	30	96.7	82	82	88	100	2550	2140	163	92.5	91.3	98	2570	2250
	40	95.3	82	83	88	99	2730	2360	163	90.9	89.7	98	2640	2310
11500	-30	90.6	91	91	92	106	2380	1990	162	90.2	88.8	94	2050	1770
	-20	92.4	90	90	92	106	2470	2060	162	92.0	90.5	94	2110	1830
	-10	94.3	90	90	92	106	2570	2150	162	93.9	92.3	94	2160	1880
	0	96.1	90	90	92	106	2660	2230	162	95.7	94.0	94	2220	1930
	10	97.9	90	90	92	106	2750	2310	162	95.3	94.2	94	2270	1980
	20	97.8	86	86	88	102	2660	2230	162	94.0	92.8	94	2330	2030
	30	96.7	82	82	85	98	2520	2110	162	92.5	91.3	94	2390	2080
	40	95.3	77	79	84	96	2390	2050	162	90.9	89.7	94	2440	2140
10500	-30	90.6	91	91	94	108	2420	2020	161	90.2	88.8	90	1910	1660
	-20	92.4	91	91	94	108	2510	2100	161	92.0	90.5	90	1960	1700
	-10	94.3	91	91	94	108	2600	2180	161	93.9	92.3	90	2010	1750
	0	96.1	91	91	94	108	2690	2270	161	95.7	94.0	90	2060	1790
	10	97.9	91	91	94	108	2780	2340	161	95.3	94.2	90	2110	1830
	20	97.8	87	87	89	104	2670	2250	161	94.0	92.8	90	2160	1880
	30	96.7	83	83	84	98	2510	2110	161	92.5	91.3	90	2210	1920
	40	95.3	78	78	80	93	2360	1970	161	90.9	89.7	90	2260	1970

Figure 7-17. Takeoff and Landing (Sheet 3 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15° | **PRESSURE ALTITUDE 3000 FEET**
LANDING - FLAPS FULL | **ANTI-ICE SYSTEMS OFF**

WT LBS	AMB. TEMP DEG C	TAKEOFF FAN PERCENT RPM	TAKEOFF V1 = KIAS ZERO WIND	TAKEOFF V1 = KIAS 20 KT WIND	TAKEOFF VR KIAS	TAKEOFF V2 KIAS	TAKEOFF FIELD LENGTH - FT ZERO WIND	TAKEOFF FIELD LENGTH - FT 20 KT WIND	CLIMB VENR KIAS	CLIMB S.E. FAN PERCENT RPM	CLIMB M.E. FAN PERCENT RPM	LANDING VREF KIAS	LANDING DISTANCE FEET ZERO WIND	LANDING DISTANCE FEET 20 KT WIND
16300	-30	92.0	93	95	102	112	2940	2540	167	91.8	90.0			
	-20	93.8	93	95	102	112	3060	2650	167	93.6	91.8			
	-10	95.7	93	95	102	112	3170	2750	167	95.4	93.6			
	0	97.5	93	95	102	112	3300	2870	167	96.3	95.4			
	10	98.6	93	95	102	112	3500	3040	167	95.3	94.1			
	20	97.8	94	96	102	112	3870	3370	167	94.0	92.7			
	30	96.7	96	97	102	112	4330	3770	167	92.5	91.2			
	40	95.3	97	99	102	112	4890	4270	167	90.9	89.7			
16000	-30	92.0	92	94	101	111	2840	2450	167	91.8	90.0			
	-20	93.8	92	94	101	111	2950	2560	167	93.6	91.8			
	-10	95.7	92	94	101	111	3070	2660	167	95.4	93.6			
	0	97.5	92	93	101	111	3190	2770	167	96.3	95.4			
	10	98.6	92	94	101	111	3370	2940	167	95.3	94.1			
	20	97.8	93	95	101	111	3730	3250	167	94.0	92.7			
	30	96.7	95	96	101	111	4170	3630	167	92.5	91.2			
	40	95.3	96	98	101	111	4710	4100	167	90.9	89.7			
15200	-30	92.0	89	91	98	109	2600	2240	166	91.8	90.0	107	2690	2340
	-20	93.8	89	91	98	109	2700	2340	166	93.6	91.8	107	2780	2420
	-10	95.7	89	91	98	109	2800	2430	166	95.4	93.6	107	2870	2500
	0	97.5	89	91	98	109	2910	2530	166	96.3	95.4	107	2960	2580
	10	98.6	89	91	98	109	3070	2670	166	95.3	94.1	107	3050	2660
	20	97.8	90	92	98	109	3380	2940	166	94.0	92.7	107	3150	2740
	30	96.7	92	93	98	109	3770	3280	166	92.5	91.2	107	3240	2830
	40	95.3	93	95	98	109	4240	3700	166	90.9	89.7	107	3340	2910
14500	-30	92.0	89	89	96	108	2520	2080	165	91.8	90.0	105	2570	2230
	-20	93.8	89	89	96	108	2620	2170	165	93.6	91.8	105	2650	2310
	-10	95.7	89	89	96	108	2720	2260	165	95.4	93.6	105	2740	2380
	0	97.5	88	88	96	107	2820	2340	165	96.4	95.4	105	2820	2460
	10	98.6	87	88	96	107	2860	2460	165	95.3	94.1	105	2900	2530
	20	97.8	87	89	96	106	3090	2690	165	94.0	92.7	105	2990	2610
	30	96.7	89	91	96	106	3440	2990	165	92.5	91.2	105	3080	2690
	40	95.3	91	92	96	106	3870	3360	165	90.9	89.7	105	3170	2770
13500	-30	92.0	89	89	92	105	2490	2060	164	91.8	90.0	101	2410	2090
	-20	93.8	89	89	92	105	2590	2150	164	93.6	91.8	101	2480	2160
	-10	95.7	89	89	92	105	2690	2240	164	95.4	93.6	101	2560	2230
	0	97.5	89	89	92	105	2780	2320	164	96.4	95.4	101	2630	2290
	10	98.6	87	87	92	105	2820	2350	164	95.3	94.1	101	2700	2360
	20	97.8	84	85	92	104	2730	2370	164	94.0	92.7	101	2780	2430
	30	96.7	85	86	92	103	3010	2610	164	92.5	91.2	101	2860	2500
	40	95.3	87	88	92	103	3370	2930	164	90.9	89.7	101	2930	2570
12500	-30	92.0	90	90	91	105	2480	2060	162	91.8	90.0	98	2260	1960
	-20	93.8	90	90	91	105	2570	2140	162	93.6	91.8	98	2320	2020
	-10	95.7	90	90	91	105	2670	2230	162	95.4	93.6	98	2390	2080
	0	97.5	89	89	91	104	2760	2310	162	96.4	95.4	98	2450	2140
	10	98.6	88	88	89	103	2790	2330	162	95.3	94.1	98	2520	2200
	20	97.8	84	84	89	101	2680	2240	162	94.0	92.7	98	2580	2260
	30	96.7	81	82	88	100	2630	2280	162	92.5	91.2	98	2650	2320
	40	95.3	82	83	88	99	2920	2530	162	90.9	89.7	98	2720	2380
11500	-30	92.0	91	91	93	107	2480	2070	161	91.8	90.0	94	2110	1830
	-20	93.8	90	90	93	107	2580	2160	161	93.6	91.8	94	2160	1880
	-10	95.7	90	90	93	107	2680	2240	161	95.3	93.6	94	2220	1930
	0	97.5	90	90	92	106	2760	2320	161	96.4	95.4	94	2280	1990
	10	98.6	89	89	91	104	2780	2340	161	95.3	94.1	94	2340	2040
	20	97.8	85	85	86	99	2660	2220	161	94.0	92.7	94	2400	2100
	30	96.7	80	80	85	97	2520	2100	161	92.5	91.2	94	2460	2150
	40	95.3	78	79	84	96	2520	2180	161	90.9	89.7	94	2520	2210
10500	-30	92.0	92	92	94	109	2520	2110	159	91.8	90.0	90	1960	1710
	-20	93.8	91	91	94	109	2610	2200	159	93.5	91.8	90	2010	1750
	-10	95.7	91	91	94	109	2710	2280	159	95.3	93.6	90	2060	1800
	0	97.5	91	91	94	108	2790	2350	159	96.4	95.4	90	2110	1840
	10	98.6	89	89	92	107	2800	2360	159	95.3	94.1	90	2160	1890
	20	97.8	85	85	87	101	2660	2230	159	94.0	92.7	90	2220	1930
	30	96.7	81	81	82	96	2500	2100	159	92.5	91.2	90	2270	1980
	40	95.3	76	76	80	93	2360	1960	159	90.9	89.7	90	2320	2030

Figure 7-17. Takeoff and Landing (Sheet 4 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 4000 FEET
ANTI-ICE SYSTEMS OFF

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	93.4	93	95	102	112	3030	2620	166	93.4	91.3			
	-20	95.3	93	95	102	112	3150	2740	166	95.1	93.1			
	-10	97.1	93	94	102	112	3270	2850	166	96.9	95.0			
	0	99.0	93	95	102	112	3440	3000	166	96.3	95.4			
	10	98.6	94	95	102	112	3730	3250	166	95.3	94.1			
	20	97.8	95	97	102	112	4150	3620	166	94.0	92.7			
	30	96.7	96	98	102	112	4660	4070	166	92.5	91.2			
16000	-30	93.4	92	94	101	111	2930	2530	166	93.4	91.3			
	-20	95.3	92	94	101	111	3050	2640	166	95.1	93.1			
	-10	97.1	91	93	101	111	3160	2750	166	96.9	95.0			
	0	99.0	92	93	101	111	3320	2890	166	96.3	95.4			
	10	98.6	92	94	101	111	3590	3130	166	95.3	94.1			
	20	97.8	94	95	101	111	4000	3490	166	94.0	92.7			
	30	96.7	95	97	101	111	4490	3910	166	92.5	91.2			
15200	-30	93.4	89	91	98	109	2680	2320	165	93.4	91.3	107	2780	2420
	-20	95.3	89	91	98	109	2780	2410	165	95.1	93.1	107	2870	2500
	-10	97.1	89	90	98	109	2890	2510	165	96.9	95.0	107	2970	2580
	0	99.0	89	90	98	109	3030	2640	165	96.3	95.4	107	3060	2670
	10	98.6	89	91	98	109	3260	2840	165	95.3	94.1	107	3160	2750
	20	97.8	91	92	98	109	3620	3150	165	94.0	92.7	107	3260	2840
	30	96.7	92	94	98	109	4050	3530	165	92.5	91.2	107	3360	2930
	40	95.3	94	95	98	109	4560	3980	165	90.9	89.7	107	3470	3020
14500	-30	93.4	89	89	96	108	2630	2180	163	93.3	91.3	105	2650	2310
	-20	95.3	89	89	96	108	2730	2270	163	95.1	93.1	105	2740	2390
	-10	97.1	89	89	96	108	2840	2360	163	96.8	95.0	105	2830	2460
	0	99.0	88	88	96	107	2910	2430	163	96.4	95.4	105	2910	2540
	10	98.6	87	88	96	107	3000	2610	163	95.3	94.1	105	3000	2620
	20	97.8	88	90	96	106	3310	2880	163	94.0	92.7	105	3090	2700
	30	96.7	90	91	96	106	3690	3210	163	92.5	91.2	105	3190	2780
	40	95.3	91	92	96	106	4150	3620	163	90.9	89.7	105	3280	2870
13500	-30	93.4	90	90	92	105	2600	2160	162	93.3	91.3	101	2480	2160
	-20	95.3	89	89	92	105	2700	2250	162	95.1	93.1	101	2560	2230
	-10	97.1	89	89	92	105	2810	2340	162	96.8	95.0	101	2640	2300
	0	99.0	88	88	92	105	2870	2400	162	96.4	95.4	101	2710	2370
	10	98.6	86	86	92	104	2840	2370	162	95.3	94.1	101	2790	2440
	20	97.8	84	86	92	103	2910	2520	162	94.0	92.7	101	2870	2510
	30	96.7	86	87	92	103	3220	2800	162	92.5	91.2	101	2950	2580
	40	95.3	87	88	92	103	3610	3140	162	90.9	89.7	101	3030	2660
12500	-30	93.4	90	90	92	105	2580	2150	161	93.3	91.3	98	2320	2020
	-20	95.3	90	90	92	105	2690	2240	161	95.1	93.1	98	2390	2080
	-10	97.1	90	90	92	105	2790	2330	161	96.8	95.0	98	2460	2140
	0	99.0	89	89	91	104	2840	2380	161	96.4	95.4	98	2530	2210
	10	98.6	86	86	89	102	2800	2350	161	95.3	94.1	98	2590	2270
	20	97.8	82	82	89	100	2680	2240	161	94.0	92.7	98	2660	2330
	30	96.7	81	82	88	99	2800	2430	161	92.5	91.2	98	2730	2400
	40	95.3	83	84	88	99	3120	2710	161	90.9	89.7	98	2810	2460
11500	-30	93.4	91	91	93	107	2590	2170	159	93.3	91.3	94	2170	1880
	-20	95.3	91	91	93	107	2690	2260	159	95.1	93.1	94	2230	1940
	-10	97.1	90	90	93	107	2790	2340	159	96.8	95.0	94	2290	1990
	0	99.0	90	90	92	106	2840	2390	159	96.4	95.4	94	2350	2050
	10	98.6	87	87	89	102	2790	2340	159	95.3	94.1	94	2410	2100
	20	97.8	83	83	85	98	2650	2220	159	94.0	92.7	94	2470	2160
	30	96.7	78	78	85	97	2520	2100	159	92.5	91.2	94	2530	2220
	40	95.3	78	79	84	96	2690	2320	159	90.9	89.7	94	2590	2280
10500	-30	93.4	92	92	95	109	2630	2210	158	93.3	91.3	90	2010	1750
	-20	95.3	91	91	95	109	2720	2290	158	95.1	93.1	90	2070	1800
	-10	97.1	91	91	95	109	2820	2380	158	96.8	95.0	90	2120	1850
	0	99.0	90	90	93	108	2870	2420	158	96.4	95.4	90	2170	1890
	10	98.6	88	88	90	104	2800	2360	158	95.3	94.1	90	2230	1940
	20	97.8	83	83	85	99	2640	2220	158	94.0	92.7	90	2280	1990
	30	96.7	79	79	80	94	2500	2090	158	92.5	91.2	90	2330	2040
	40	95.3	74	75	80	93	2360	1980	158	90.9	89.7	90	2390	2090

Figure 7-17. Takeoff and Landing (Sheet 5 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 5000 FEET
ANTI-ICE SYSTEMS OFF

WT	AMB. TEMP	TAKEOFF FAN	TAKEOFF V1 = KIAS		TAKEOFF VR	TAKEOFF V2	TAKEOFF FIELD LENGTH - FT		CLIMB VENR	CLIMB S.E. FAN	CLIMB M.E. FAN	LANDING VREF	LANDING DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	95.3	93	94	102	112	3110	2700	165	94.9	92.6			
	-20	97.2	92	94	102	112	3250	2820	165	96.6	94.4			
	-10	99.0	93	94	102	112	3420	2980	165	97.3	96.3			
	0	99.0	93	95	102	112	3660	3190	165	96.3	95.4			
	10	98.6	94	96	102	112	4010	3500	165	95.3	94.1			
	20	97.8	95	97	102	112	4470	3900	165	94.0	92.6			
	30	96.7	97	98	102	112	5020	4380	165	92.5	91.2			
16000	-30	95.3	92	93	101	111	3010	2610	164	94.9	92.6			
	-20	97.2	91	93	101	111	3140	2730	164	96.6	94.4			
	-10	99.0	91	93	101	111	3310	2870	164	97.3	96.3			
	0	99.0	92	94	101	111	3530	3080	164	96.3	95.4			
	10	98.6	93	95	101	111	3860	3370	164	95.3	94.1			
	20	97.8	94	96	101	111	4300	3750	164	94.0	92.6			
	30	96.7	96	97	101	111	4830	4220	164	92.5	91.2			
15200	-30	95.3	89	91	98	110	2780	2380	163	94.9	92.6	107	2870	2500
	-20	97.2	89	90	98	109	2890	2490	163	96.5	94.4	107	2970	2590
	-10	99.0	89	90	98	109	3020	2620	163	97.3	96.3	107	3070	2670
	0	99.0	89	91	98	109	3210	2800	163	96.3	95.4	107	3170	2760
	10	98.6	90	92	98	109	3500	3050	163	95.3	94.1	107	3280	2860
	20	97.8	91	93	98	109	3880	3390	163	94.0	92.6	107	3380	2950
	30	96.7	93	94	98	109	4350	3790	163	92.5	91.2	107	3490	3040
	40	95.3	94	95	98	108	4910	4290	163	90.9	89.6	107	3600	3140
14500	-30	95.3	90	90	96	108	2760	2290	162	94.9	92.6	105	2740	2380
	-20	97.2	89	89	96	108	2860	2380	162	96.5	94.4	105	2830	2470
	-10	99.0	88	88	96	107	2930	2440	162	97.3	96.3	105	2920	2550
	0	99.0	86	88	96	107	2960	2570	162	96.3	95.4	105	3010	2630
	10	98.6	87	89	96	106	3200	2790	162	95.3	94.1	105	3110	2710
	20	97.8	89	90	96	106	3550	3090	162	94.0	92.6	105	3200	2800
	30	96.7	90	91	96	106	3960	3450	162	92.5	91.2	105	3300	2880
	40	95.3	91	93	96	106	4470	3890	162	90.9	89.6	105	3400	2970
13500	-30	95.3	90	90	92	105	2730	2270	160	94.8	92.6	101	2560	2230
	-20	97.2	90	90	92	105	2830	2360	160	96.5	94.4	101	2640	2300
	-10	99.0	89	89	92	105	2890	2410	160	97.3	96.3	101	2720	2380
	0	99.0	87	87	92	104	2900	2420	160	96.4	95.4	101	2800	2450
	10	98.6	84	85	92	104	2840	2460	160	95.3	94.1	101	2880	2520
	20	97.8	84	86	92	103	3100	2700	160	94.0	92.6	101	2970	2600
	30	96.7	86	87	92	103	3450	3000	160	92.5	91.2	101	3050	2670
	40	95.3	88	89	92	103	3880	3380	160	90.9	89.6	101	3140	2750
12500	-30	95.3	91	91	92	106	2710	2270	159	94.8	92.6	98	2390	2080
	-20	97.2	90	90	92	106	2810	2350	159	96.5	94.4	98	2460	2150
	-10	99.0	89	89	91	104	2860	2400	159	97.3	96.3	98	2530	2210
	0	99.0	87	87	89	102	2860	2400	159	96.4	95.4	98	2600	2280
	10	98.6	84	84	89	101	2800	2340	159	95.3	94.1	98	2680	2340
	20	97.8	80	82	88	100	2710	2350	159	94.0	92.6	98	2750	2410
	30	96.7	82	83	88	99	2990	2600	159	92.5	91.2	98	2820	2480
	40	95.3	83	84	88	99	3350	2910	159	90.9	89.6	98	2900	2550
11500	-30	95.3	91	91	94	108	2720	2280	158	94.8	92.6	94	2230	1940
	-20	97.2	91	91	94	108	2810	2370	158	96.5	94.4	94	2290	2000
	-10	99.0	90	90	92	106	2860	2410	158	97.3	96.3	94	2350	2050
	0	99.0	88	88	90	104	2850	2400	158	96.4	95.4	94	2420	2110
	10	98.6	85	85	86	100	2770	2330	158	95.3	94.1	94	2480	2170
	20	97.8	81	81	85	97	2650	2220	158	94.0	92.6	94	2550	2230
	30	96.7	77	79	84	96	2590	2240	158	92.5	91.2	94	2610	2290
	40	95.3	78	80	84	95	2870	2490	158	90.9	89.6	94	2680	2350
10500	-30	95.3	92	92	95	110	2760	2320	157	94.8	92.6	90	2070	1800
	-20	97.2	92	92	95	110	2850	2410	157	96.5	94.4	90	2120	1850
	-10	99.0	91	91	94	109	2890	2440	157	97.3	96.3	90	2180	1900
	0	99.0	89	89	91	106	2870	2420	157	96.4	95.4	90	2240	1950
	10	98.6	85	85	88	102	2770	2330	157	95.3	94.1	90	2290	2000
	20	97.8	81	81	83	96	2630	2210	157	94.0	92.6	90	2350	2050
	30	96.7	77	77	80	93	2500	2090	157	92.5	91.2	90	2400	2110
	40	95.3	74	75	80	92	2450	2110	157	90.9	89.6	90	2460	2160

Figure 7-17. Takeoff and Landing (Sheet 6 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 6000 FEET
ANTI-ICE SYSTEMS OFF

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	97.3	92	94	102	112	3200	2780	164	96.4	94.7			
	-20	99.0	92	94	102	112	3350	2920	164	98.0	96.5			
	-10	99.0	93	94	102	112	3610	3150	164	97.2	96.4			
	0	99.0	93	95	102	112	3910	3420	164	96.3	95.3			
	10	98.6	95	96	102	112	4310	3770	164	95.3	94.0			
	20	97.8	96	97	102	112	4810	4200	164	94.0	92.6			
16000	-30	97.3	91	93	101	112	3090	2690	163	96.4	94.7			
	-20	99.0	91	93	101	111	3240	2820	163	98.0	96.5			
	-10	99.0	92	93	101	111	3480	3030	163	97.3	96.4			
	0	99.0	92	94	101	111	3770	3290	163	96.3	95.3			
	10	98.6	94	95	101	111	4150	3630	163	95.3	94.0			
	20	97.8	95	96	101	111	4630	4050	163	94.0	92.6			
	30	96.7	96	98	101	111	5200	4550	163	92.5	91.1			
15200	-30	97.3	90	90	98	110	2920	2460	162	96.4	94.7	107	2970	2590
	-20	99.0	89	90	98	110	3020	2570	162	98.0	96.5	107	3080	2680
	-10	99.0	89	90	98	109	3170	2760	162	97.3	96.4	107	3180	2770
	0	99.0	89	91	98	109	3420	2980	162	96.3	95.3	107	3290	2870
	10	98.6	91	92	98	109	3750	3280	162	95.3	94.0	107	3400	2960
	20	97.8	92	93	98	109	4170	3650	162	94.0	92.6	107	3510	3060
	30	96.7	93	95	98	109	4680	4090	162	92.5	91.1	107	3630	3160
14500	-30	97.3	90	90	96	108	2890	2410	161	96.4	94.7	105	2830	2470
	-20	99.0	89	89	96	108	2990	2490	161	98.0	96.5	105	2930	2550
	-10	99.0	87	88	96	107	2990	2540	161	97.3	96.4	105	3020	2640
	0	99.0	87	88	96	107	3140	2730	161	96.3	95.3	105	3120	2720
	10	98.6	88	89	96	106	3430	2990	161	95.3	94.0	105	3220	2810
	20	97.8	89	91	96	106	3800	3320	161	94.0	92.6	105	3320	2900
	30	96.7	91	92	96	106	4250	3710	161	92.5	91.1	105	3420	2990
	40	95.3	92	93	96	106	4800	4200	161	90.9	89.6	105	3530	3080
13500	-30	97.3	90	90	92	105	2860	2390	159	96.3	94.7	101	2640	2300
	-20	99.0	90	90	92	105	2960	2470	159	98.0	96.5	101	2730	2380
	-10	99.0	88	88	92	105	2950	2460	159	97.3	96.4	101	2810	2460
	0	99.0	85	85	92	104	2920	2440	159	96.3	95.3	101	2900	2530
	10	98.6	84	85	92	103	3010	2620	159	95.3	94.0	101	2980	2610
	20	97.8	85	86	92	103	3320	2890	159	94.0	92.6	101	3070	2690
	30	96.7	86	88	92	103	3700	3230	159	92.5	91.1	101	3160	2770
	40	95.3	88	89	92	103	4160	3630	159	90.9	89.6	101	3250	2850
12500	-30	97.3	91	91	93	107	2840	2380	158	96.3	94.7	98	2460	2150
	-20	99.0	90	90	93	106	2940	2460	158	98.0	96.5	98	2540	2210
	-10	99.0	88	88	90	103	2920	2450	158	97.3	96.4	98	2610	2280
	0	99.0	85	85	89	101	2880	2410	158	96.4	95.3	98	2690	2350
	10	98.6	82	82	89	101	2800	2340	158	95.3	94.0	98	2760	2420
	20	97.8	81	82	88	100	2890	2510	158	94.0	92.6	98	2840	2490
	30	96.7	82	83	88	99	3200	2780	158	92.5	91.1	98	2920	2560
	40	95.3	84	85	88	99	3590	3120	158	90.9	89.6	98	3000	2630
11500	-30	97.3	92	92	94	109	2850	2400	156	96.3	94.7	94	2290	2000
	-20	99.0	91	91	94	108	2940	2480	156	97.9	96.5	94	2360	2060
	-10	99.0	89	89	91	105	2910	2450	156	97.3	96.4	94	2430	2120
	0	99.0	86	86	88	102	2860	2400	156	96.4	95.3	94	2490	2180
	10	98.6	83	83	85	98	2760	2320	156	95.3	94.0	94	2560	2240
	20	97.8	79	79	85	97	2650	2220	156	94.0	92.6	94	2620	2300
	30	96.7	78	79	84	96	2750	2390	156	92.5	91.1	94	2690	2360
	40	95.3	79	80	84	95	3070	2670	156	90.9	89.6	94	2760	2430
10500	-30	97.3	93	93	96	111	2890	2440	155	96.3	94.7	90	2130	1850
	-20	99.0	92	92	96	110	2980	2520	155	97.9	96.5	90	2180	1900
	-10	99.0	90	90	93	107	2930	2480	155	97.3	96.4	90	2240	1960
	0	99.0	87	87	89	104	2860	2420	155	96.4	95.3	90	2300	2010
	10	98.6	83	83	85	99	2750	2320	155	95.3	94.0	90	2360	2060
	20	97.8	79	79	80	94	2620	2200	155	94.0	92.6	90	2420	2120
	30	96.7	75	75	80	93	2500	2090	155	92.5	91.1	90	2480	2170
	40	95.3	74	75	80	92	2600	2250	155	90.9	89.6	90	2540	2230

Figure 7-17. Takeoff and Landing (Sheet 7 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 7000 FEET
ANTI-ICE SYSTEMS OFF

WT	AMB. TEMP	TAKEOFF FAN	TAKEOFF V1 = KIAS		TAKEOFF VR	TAKEOFF V2	TAKEOFF FIELD LENGTH - FT		CLIMB VENR	CLIMB S.E. FAN	CLIMB M.E. FAN	LANDING VREF	LANDING DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	99.0	92	94	102	112	3370	2930	163	98.8	96.8			
	-20	99.0	93	94	102	112	3580	3130	163	98.1	97.3			
	-10	99.0	93	95	102	112	3880	3380	163	97.2	96.4			
	0	99.0	94	96	102	112	4210	3680	163	96.3	95.3			
	10	98.6	95	97	102	112	4640	4060	163	95.2	94.0			
	20	97.8	96	98	102	112	5190	4540	163	94.0	92.6			
16000	-30	99.0	91	93	101	111	3250	2830	162	98.8	96.8			
	-20	99.0	91	93	101	111	3460	3010	162	98.1	97.3			
	-10	99.0	92	94	101	111	3740	3260	162	97.2	96.4			
	0	99.0	93	95	101	111	4050	3540	162	96.3	95.3			
	10	98.6	94	96	101	111	4470	3910	162	95.2	94.0			
	20	97.8	95	97	101	111	4990	4360	162	94.0	92.6			
15200	-30	99.0	89	90	98	109	2990	2580	161	98.8	96.8	107	3080	2680
	-20	99.0	89	90	98	109	3150	2740	161	98.1	97.3	107	3190	2780
	-10	99.0	89	91	98	109	3390	2950	161	97.2	96.4	107	3300	2870
	0	99.0	90	92	98	109	3670	3200	161	96.3	95.3	107	3410	2970
	10	98.6	91	93	98	109	4040	3530	161	95.3	94.0	107	3530	3080
	20	97.8	92	94	98	109	4490	3930	161	94.0	92.6	107	3650	3180
	30	96.7	94	95	98	108	5040	4410	161	92.5	91.1	107	3770	3290
14500	-30	99.0	89	89	96	108	2960	2460	160	98.8	96.8	105	2930	2550
	-20	99.0	87	88	96	107	3000	2520	160	98.1	97.3	105	3030	2640
	-10	99.0	86	88	96	107	3110	2710	160	97.3	96.4	105	3130	2730
	0	99.0	87	89	96	106	3350	2920	160	96.3	95.3	105	3230	2820
	10	98.6	88	90	96	106	3680	3210	160	95.3	94.0	105	3340	2920
	20	97.8	90	91	96	106	4090	3570	160	94.0	92.6	105	3440	3010
	30	96.7	91	92	96	106	4580	4000	160	92.5	91.1	105	3550	3110
13500	-30	99.0	89	89	92	105	2920	2440	158	98.8	96.8	101	2730	2380
	-20	99.0	88	88	92	105	2960	2480	158	98.1	97.3	101	2820	2460
	-10	99.0	86	86	92	104	2950	2460	158	97.3	96.4	101	2900	2540
	0	99.0	83	85	92	104	2950	2570	158	96.3	95.3	101	2990	2620
	10	98.6	84	86	92	103	3220	2800	158	95.3	94.0	101	3090	2700
	20	97.8	86	87	92	103	3560	3100	158	94.0	92.6	101	3180	2790
	30	96.7	87	88	92	103	3980	3470	158	92.5	91.1	101	3270	2870
	40	95.3	88	89	92	103	4480	3910	158	90.9	89.5	101	3370	2960
12500	-30	99.0	90	90	92	105	2900	2430	156	98.8	96.8	98	2540	2220
	-20	99.0	88	88	90	104	2930	2460	156	98.1	97.3	98	2620	2290
	-10	99.0	86	86	89	102	2910	2440	156	97.3	96.4	98	2700	2360
	0	99.0	83	83	89	101	2880	2410	156	96.4	95.3	98	2770	2430
	10	98.6	80	82	88	100	2810	2450	156	95.3	94.0	98	2850	2500
	20	97.8	81	83	88	99	3080	2680	156	94.0	92.6	98	2930	2580
	30	96.7	83	84	88	99	3430	2990	156	92.5	91.1	98	3020	2650
	40	95.3	84	85	88	99	3850	3360	156	90.9	89.5	98	3100	2730
11500	-30	99.0	91	91	93	107	2900	2440	155	98.8	96.8	94	2360	2060
	-20	99.0	89	89	92	105	2930	2460	155	98.1	97.3	94	2430	2120
	-10	99.0	87	87	89	102	2890	2430	155	97.3	96.4	94	2500	2190
	0	99.0	84	84	86	99	2850	2390	155	96.4	95.3	94	2570	2250
	10	98.6	81	81	85	97	2760	2320	155	95.3	94.0	94	2640	2310
	20	97.8	77	78	84	96	2670	2320	155	94.0	92.6	94	2710	2380
	30	96.7	78	79	84	95	2940	2550	155	92.5	91.1	94	2780	2440
	40	95.3	80	81	84	95	3290	2860	155	90.9	89.5	94	2850	2510
10500	-30	99.0	91	91	95	110	2930	2480	154	98.8	96.8	90	2190	1900
	-20	99.0	90	90	93	108	2950	2490	154	98.1	97.3	90	2250	1960
	-10	99.0	87	87	90	104	2900	2450	154	97.3	96.4	90	2310	2020
	0	99.0	85	85	87	101	2840	2400	154	96.4	95.3	90	2370	2070
	10	98.6	81	81	83	96	2740	2310	154	95.3	94.0	90	2430	2130
	20	97.8	77	77	80	93	2620	2200	154	94.0	92.6	90	2490	2190
	30	96.7	73	75	80	92	2510	2170	154	92.5	91.1	90	2550	2240
	40	95.3	75	76	80	91	2780	2410	154	90.9	89.5	90	2620	2300

Figure 7-17. Takeoff and Landing (Sheet 8 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE SEA LEVEL
ANTI-ICE SYSTEMS ON

WT LBS	AMB. TEMP DEG C	TAKEOFF FAN PERCENT RPM	TAKEOFF V1 = KIAS ZERO WIND	TAKEOFF V1 = KIAS 20 KT WIND	TAKEOFF VR KIAS	TAKEOFF V2 KIAS	TAKEOFF FIELD LENGTH - FT ZERO WIND	TAKEOFF FIELD LENGTH - FT 20 KT WIND	CLIMB VENR KIAS	CLIMB S.E. FAN PERCENT RPM	CLIMB M.E. FAN PERCENT RPM	LANDING VREF KIAS	LANDING DISTANCE FEET ZERO WIND	LANDING DISTANCE FEET 20 KT WIND
16300	-30	87.9	96	97	102	112	2970	2550	172	87.9	86.2			
	-20	89.7	95	97	102	112	3090	2650	172	89.7	87.9			
	-10	91.5	95	97	102	112	3200	2760	172	91.5	89.6			
	0	93.2	95	97	102	112	3320	2870	172	93.3	91.2			
	10	95.0	95	97	102	112	3440	2980	172	92.0	92.5			
16000	-30	87.9	95	96	101	111	2870	2460	171	87.9	86.2			
	-20	89.7	94	96	101	111	2980	2560	171	89.7	87.9			
	-10	91.5	94	96	101	111	3090	2660	171	91.5	89.6			
	0	93.2	94	96	101	111	3210	2770	171	93.3	91.2			
	10	95.0	94	95	101	111	3320	2880	171	92.0	92.5			
15200	-30	87.9	91	93	98	109	2620	2240	170	87.9	86.2	107	2450	2120
	-20	89.7	91	93	98	109	2720	2340	170	89.7	87.9	107	2530	2190
	-10	91.5	91	93	98	109	2830	2430	170	91.5	89.6	107	2610	2260
	0	93.2	91	93	98	109	2930	2520	170	93.2	91.2	107	2690	2330
	10	95.0	91	92	98	109	3030	2620	170	92.0	92.5	107	2770	2400
14500	-30	87.9	89	91	96	107	2440	2070	169	87.9	86.2	105	2350	2040
	-20	89.7	89	90	96	107	2530	2160	169	89.7	87.9	105	2420	2100
	-10	91.5	89	90	96	107	2630	2240	169	91.4	89.6	105	2490	2170
	0	93.2	89	90	96	107	2730	2320	169	93.2	91.2	105	2570	2230
	10	95.0	89	90	96	107	2830	2410	169	92.0	92.5	105	2640	2300
13500	-30	87.9	90	90	92	105	2410	1980	168	87.9	86.2	101	2210	1910
	-20	89.7	90	90	92	105	2510	2070	168	89.7	87.9	101	2270	1970
	-10	91.5	89	89	92	105	2610	2160	168	91.4	89.6	101	2340	2030
	0	93.2	89	89	92	105	2700	2230	168	93.2	91.2	101	2400	2090
	10	95.0	89	89	92	105	2790	2320	168	92.0	92.5	101	2470	2150
12500	-30	87.9	90	90	90	103	2400	1980	167	87.9	86.2	98	2080	1790
	-20	89.7	90	90	90	103	2500	2070	167	89.6	87.9	98	2130	1850
	-10	91.5	90	90	90	103	2590	2150	167	91.4	89.6	98	2190	1900
	0	93.2	90	90	90	103	2680	2220	167	93.2	91.2	98	2250	1950
	10	95.0	90	90	90	103	2770	2310	167	92.0	92.5	98	2310	2010
11500	-30	87.9	91	91	91	105	2410	1990	165	87.8	86.2	94	1940	1680
	-20	89.7	91	91	91	105	2500	2080	165	89.6	87.9	94	2000	1730
	-10	91.5	91	91	91	105	2600	2160	165	91.4	89.6	94	2050	1770
	0	93.2	90	90	91	105	2680	2230	165	93.2	91.2	94	2100	1820
	10	95.0	90	90	91	105	2770	2320	165	92.0	92.5	94	2150	1870
10500	-30	87.9	92	92	92	107	2440	2050	164	87.8	86.2	90	1820	1580
	-20	89.7	92	92	92	107	2530	2120	164	89.6	87.9	90	1860	1620
	-10	91.5	92	92	93	107	2630	2200	164	91.4	89.6	90	1900	1660
	0	93.2	91	91	92	107	2720	2280	164	93.2	91.2	90	1950	1700
	10	95.0	91	91	92	107	2810	2350	164	92.0	92.5	90	2000	1740

Figure 7-18. Takeoff and Landing (Sheet 1 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15° | **PRESSURE ALTITUDE 1000 FEET**
LANDING - FLAPS FULL | **ANTI-ICE SYSTEMS ON**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	89.3	95	97	102	112	3060	2630	170	89.1	87.5			
	-20	91.1	95	97	102	112	3180	2740	170	90.9	89.2			
	-10	92.9	95	97	102	112	3290	2850	170	92.7	90.9			
	0	94.7	95	96	102	112	3410	2960	170	93.3	92.6			
	10	96.1	94	96	102	112	3540	3070	170	92.0	92.5			
16000	-30	89.3	94	96	101	111	2950	2540	170	89.1	87.5			
	-20	91.1	94	96	101	111	3070	2640	170	90.9	89.2			
	-10	92.9	94	95	101	111	3180	2750	170	92.7	90.9			
	0	94.7	93	95	101	111	3300	2860	170	93.3	92.6			
	10	96.1	93	95	101	111	3420	2970	170	92.0	92.5			
15200	-30	89.3	91	93	98	109	2700	2310	169	89.1	87.5	107	2530	2190
	-20	91.1	91	93	98	109	2810	2410	169	90.9	89.2	107	2610	2260
	-10	92.9	91	92	98	109	2900	2510	169	92.7	90.9	107	2690	2340
	0	94.7	90	92	98	109	3010	2610	169	93.3	92.6	107	2770	2410
	10	96.1	90	92	98	109	3110	2710	169	92.0	92.5	107	2860	2490
14500	-30	89.3	89	90	96	107	2540	2130	168	89.1	87.5	105	2420	2100
	-20	91.1	89	90	96	107	2640	2220	168	90.9	89.2	105	2500	2170
	-10	92.9	89	90	96	107	2750	2310	168	92.7	90.9	105	2570	2230
	0	94.7	89	90	96	107	2850	2400	168	93.3	92.6	105	2650	2300
	10	96.1	89	89	96	107	2960	2490	168	92.0	92.5	105	2720	2370
13500	-30	89.3	90	90	92	105	2520	2080	166	89.1	87.5	101	2270	1970
	-20	91.1	90	90	92	105	2620	2170	166	90.9	89.2	101	2340	2030
	-10	92.9	90	90	92	105	2720	2260	166	92.7	90.9	101	2410	2090
	0	94.7	90	90	92	105	2820	2340	166	93.3	92.6	101	2470	2150
	10	96.1	89	89	92	105	2920	2430	166	92.0	92.5	101	2540	2220
12500	-30	89.3	90	90	90	104	2510	2070	165	89.0	87.5	98	2130	1850
	-20	91.1	90	90	90	104	2610	2160	165	90.9	89.2	98	2190	1900
	-10	92.9	90	90	90	104	2700	2240	165	92.7	90.9	98	2250	1960
	0	94.7	90	90	90	104	2790	2330	165	93.3	92.6	98	2310	2010
	10	96.1	90	90	90	103	2890	2420	165	92.0	92.5	98	2370	2070
11500	-30	89.3	91	91	92	105	2510	2090	164	89.0	87.5	94	2000	1730
	-20	91.1	91	91	92	105	2610	2170	164	90.8	89.2	94	2050	1770
	-10	92.9	91	91	92	105	2710	2260	164	92.6	90.9	94	2100	1820
	0	94.7	91	91	92	105	2810	2340	164	93.3	92.6	94	2160	1870
	10	96.1	91	91	91	105	2890	2420	164	92.0	92.5	94	2210	1920
10500	-30	89.3	92	92	93	108	2550	2130	163	89.0	87.5	90	1860	1620
	-20	91.1	92	92	93	108	2640	2210	163	90.8	89.2	90	1910	1660
	-10	92.9	92	92	93	108	2740	2300	163	92.6	90.9	90	1950	1700
	0	94.7	92	92	93	108	2840	2380	163	93.3	92.6	90	2000	1740
	10	96.1	91	91	93	108	2930	2460	163	92.0	92.5	90	2050	1790

Figure 7-18. Takeoff and Landing (Sheet 2 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15° **PRESSURE ALTITUDE 2000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS ON**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	90.6	95	97	102	112	3140	2710	169	90.3	88.8			
	-20	92.4	95	96	102	112	3270	2830	169	92.1	90.5			
	-10	94.3	94	96	102	112	3390	2940	169	93.9	92.3			
	0	96.1	94	96	102	112	3510	3050	169	93.3	93.7			
	10	96.1	94	96	102	112	3640	3170	169	92.0	92.4			
16000	-30	90.6	94	96	101	111	3040	2620	168	90.3	88.8			
	-20	92.4	93	95	101	111	3160	2730	168	92.1	90.5			
	-10	94.3	93	95	101	111	3280	2840	168	93.9	92.3			
	0	96.1	93	95	101	111	3390	2940	168	93.3	93.7			
	10	96.1	93	95	101	111	3520	3060	168	92.0	92.4			
15200	-30	90.6	91	93	98	109	2770	2390	167	90.3	88.8	107	2610	2260
	-20	92.4	91	92	98	109	2880	2490	167	92.1	90.5	107	2690	2340
	-10	94.3	90	92	98	109	2990	2590	167	93.9	92.3	107	2780	2410
	0	96.1	90	92	98	109	3090	2680	167	93.3	93.7	107	2860	2490
	10	96.1	90	92	98	109	3210	2780	167	92.0	92.4	107	2950	2570
14500	-30	90.6	90	90	96	107	2650	2200	166	90.3	88.8	105	2490	2160
	-20	92.4	90	90	96	107	2760	2290	166	92.1	90.5	105	2570	2240
	-10	94.3	89	90	96	107	2870	2390	166	93.9	92.3	105	2650	2310
	0	96.1	89	89	96	107	2980	2480	166	93.3	93.7	105	2730	2380
	10	96.1	89	89	96	107	3090	2560	166	92.0	92.4	105	2810	2450
13500	-30	90.6	90	90	92	105	2630	2170	165	90.3	88.8	101	2340	2030
	-20	92.4	90	90	92	105	2730	2270	165	92.1	90.5	101	2410	2090
	-10	94.3	90	90	92	105	2840	2350	165	93.9	92.3	101	2480	2160
	0	96.1	90	90	92	105	2950	2450	165	93.3	93.7	101	2550	2220
	10	96.1	90	90	92	105	3050	2540	165	92.0	92.4	101	2620	2290
12500	-30	90.6	91	91	91	104	2620	2170	163	90.2	88.8	98	2190	1900
	-20	92.4	91	91	91	104	2720	2260	163	92.1	90.5	98	2260	1960
	-10	94.3	90	90	91	104	2820	2340	163	93.9	92.3	98	2320	2020
	0	96.1	90	90	91	104	2930	2440	163	93.3	93.7	98	2380	2070
	10	96.1	90	90	91	104	3030	2530	163	92.0	92.4	98	2440	2130
11500	-30	90.6	92	92	92	106	2620	2190	162	90.2	88.8	94	2050	1770
	-20	92.4	91	91	92	106	2720	2270	162	92.0	90.5	94	2110	1830
	-10	94.3	91	91	92	106	2830	2370	162	93.9	92.3	94	2160	1880
	0	96.1	91	91	92	106	2930	2450	162	93.3	93.7	94	2220	1930
	10	96.1	91	91	92	106	3030	2540	162	92.0	92.4	94	2270	1980
10500	-30	90.6	92	92	94	108	2660	2220	161	90.2	88.8	90	1910	1660
	-20	92.4	92	92	94	108	2760	2310	161	92.0	90.5	90	1960	1700
	-10	94.3	92	92	94	108	2860	2400	161	93.9	92.3	90	2010	1750
	0	96.1	92	92	94	108	2960	2500	161	93.3	93.7	90	2060	1790
	10	96.1	92	92	94	108	3060	2570	161	92.0	92.4	90	2110	1830

Figure 7-18. Takeoff and Landing (Sheet 3 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15° **PRESSURE ALTITUDE 3000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS ON**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	92.0	94	96	102	112	3230	2790	167	91.8	90.0			
	-20	93.8	94	96	102	112	3370	2920	167	93.6	91.8			
	-10	95.7	94	96	102	112	3490	3030	167	94.4	93.6			
	0	97.1	94	96	102	112	3630	3160	167	93.3	93.6			
	10	96.1	94	96	102	112	3850	3340	167	92.0	92.4			
16000	-30	92.0	93	95	101	111	3120	2700	167	91.8	90.0			
	-20	93.8	93	95	101	111	3250	2820	167	93.6	91.8			
	-10	95.7	93	95	101	111	3380	2930	167	94.4	93.6			
	0	97.1	93	94	101	111	3510	3050	167	93.3	93.6			
	10	96.1	93	95	101	111	3710	3230	167	92.0	92.4			
15200	-30	92.0	90	92	98	109	2860	2460	166	91.8	90.0	107	2690	2340
	-20	93.8	90	92	98	109	2970	2570	166	93.6	91.8	107	2780	2420
	-10	95.7	90	92	98	109	3080	2670	166	94.4	93.6	107	2870	2500
	0	97.1	90	92	98	109	3200	2780	166	93.3	93.6	107	2960	2580
	10	96.1	90	92	98	109	3380	2940	166	92.0	92.4	107	3050	2660
14500	-30	92.0	90	90	96	108	2770	2290	165	91.8	90.0	105	2570	2230
	-20	93.8	90	90	96	108	2880	2390	165	93.6	91.8	105	2650	2310
	-10	95.7	90	90	96	108	2990	2490	165	94.4	93.6	105	2740	2380
	0	97.1	89	89	96	107	3100	2570	165	93.3	93.6	105	2820	2460
	10	96.1	88	89	96	107	3150	2710	165	92.0	92.4	105	2900	2530
13500	-30	92.0	90	90	92	105	2740	2270	164	91.8	90.0	101	2410	2090
	-20	93.8	90	90	92	105	2850	2370	164	93.6	91.8	101	2480	2160
	-10	95.7	90	90	92	105	2960	2460	164	94.4	93.6	101	2560	2230
	0	97.1	90	90	92	105	3060	2550	164	93.3	93.6	101	2630	2290
	10	96.1	88	88	92	105	3100	2590	164	92.0	92.4	101	2700	2360
12500	-30	92.0	91	91	91	105	2730	2270	162	91.8	90.0	98	2260	1960
	-20	93.8	91	91	91	105	2830	2350	162	93.6	91.8	98	2320	2020
	-10	95.7	91	91	91	105	2940	2450	162	94.4	93.6	98	2390	2080
	0	97.1	90	90	91	104	3040	2540	162	93.3	93.6	98	2450	2140
	10	96.1	89	89	89	103	3070	2560	162	92.0	92.4	98	2520	2200
11500	-30	92.0	92	92	93	107	2730	2280	161	91.8	90.0	94	2110	1830
	-20	93.8	91	91	93	107	2840	2380	161	93.6	91.8	94	2160	1880
	-10	95.7	91	91	93	107	2950	2460	161	94.4	93.6	94	2220	1930
	0	97.1	91	91	92	106	3040	2550	161	93.3	93.6	94	2280	1990
	10	96.1	90	90	91	104	3060	2570	161	92.0	92.4	94	2340	2040
10500	-30	92.0	93	93	94	109	2770	2320	159	91.8	90.0	90	1960	1710
	-20	93.8	92	92	94	109	2870	2420	159	93.5	91.8	90	2010	1750
	-10	95.7	92	92	94	109	2980	2510	159	94.4	93.6	90	2060	1800
	0	97.1	92	92	94	108	3070	2590	159	93.3	93.6	90	2110	1840
	10	96.1	90	90	92	107	3080	2600	159	92.0	92.4	90	2160	1890

Figure 7-18. Takeoff and Landing (Sheet 4 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 4000 FEET
ANTI-ICE SYSTEMS ON

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	93.4	94	96	102	112	3330	2880	166	93.4	91.3			
	-20	95.3	94	96	102	112	3470	3010	166	95.1	93.1			
	-10	97.1	94	95	102	112	3600	3140	166	94.4	94.7			
	0	97.1	94	96	102	112	3780	3300	166	93.3	93.6			
	10	96.1	95	96	102	112	4100	3580	166	92.0	92.4			
16000	-30	93.4	93	95	101	111	3220	2780	166	93.4	91.3			
	-20	95.3	93	95	101	111	3360	2900	166	95.1	93.1			
	-10	97.1	92	94	101	111	3480	3030	166	94.4	94.7			
	0	97.1	93	94	101	111	3650	3180	166	93.3	93.6			
	10	96.1	93	95	101	111	3950	3440	166	92.0	92.4			
15200	-30	93.4	90	92	98	109	2950	2550	165	93.4	91.3	107	2780	2420
	-20	95.3	90	92	98	109	3060	2650	165	95.1	93.1	107	2870	2500
	-10	97.1	90	91	98	109	3180	2760	165	94.4	94.7	107	2970	2580
	0	97.1	90	91	98	109	3330	2900	165	93.3	93.6	107	3060	2670
	10	96.1	90	92	98	109	3590	3120	165	92.0	92.4	107	3160	2750
14500	-30	93.4	90	90	96	108	2890	2400	163	93.3	91.3	105	2650	2310
	-20	95.3	90	90	96	108	3000	2500	163	95.1	93.1	105	2740	2390
	-10	97.1	90	90	96	108	3120	2600	163	94.4	94.7	105	2830	2460
	0	97.1	89	89	96	107	3200	2670	163	93.3	93.6	105	2910	2540
	10	96.1	88	89	96	107	3300	2870	163	92.0	92.4	105	3000	2620
13500	-30	93.4	91	91	92	105	2860	2380	162	93.3	91.3	101	2480	2160
	-20	95.3	90	90	92	105	2970	2480	162	95.1	93.1	101	2560	2230
	-10	97.1	90	90	92	105	3090	2570	162	94.4	94.7	101	2640	2300
	0	97.1	89	89	92	105	3160	2640	162	93.3	93.6	101	2710	2370
	10	96.1	87	87	92	104	3120	2610	162	92.0	92.4	101	2790	2440
12500	-30	93.4	91	91	92	105	2840	2370	161	93.3	91.3	98	2320	2020
	-20	95.3	91	91	92	105	2960	2460	161	95.1	93.1	98	2390	2080
	-10	97.1	91	91	92	105	3070	2560	161	94.4	94.7	98	2460	2140
	0	97.1	90	90	91	104	3120	2620	161	93.3	93.6	98	2530	2210
	10	96.1	87	87	89	102	3080	2590	161	92.0	92.4	98	2590	2270
11500	-30	93.4	92	92	93	107	2850	2390	159	93.3	91.3	94	2170	1880
	-20	95.3	92	92	93	107	2960	2490	159	95.1	93.1	94	2230	1940
	-10	97.1	91	91	93	107	3070	2570	159	94.4	94.7	94	2290	1990
	0	97.1	91	91	92	106	3120	2630	159	93.3	93.6	94	2350	2050
	10	96.1	88	88	89	102	3070	2570	159	92.0	92.4	94	2410	2100
10500	-30	93.4	93	93	95	109	2890	2430	158	93.3	91.3	90	2010	1750
	-20	95.3	92	92	95	109	2990	2520	158	95.1	93.1	90	2070	1800
	-10	97.1	92	92	95	109	3100	2620	158	94.4	94.7	90	2120	1850
	0	97.1	91	91	93	108	3160	2660	158	93.3	93.6	90	2170	1890
	10	96.1	89	89	90	104	3080	2600	158	92.0	92.4	90	2230	1940

Figure 7-18. Takeoff and Landing (Sheet 5 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 5000 FEET
ANTI-ICE SYSTEMS ON

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	95.3	94	95	102	112	3420	2970	165	94.9	92.6			
	-20	97.2	93	95	102	112	3580	3100	165	95.4	94.4			
	-10	98.0	94	95	102	112	3760	3280	165	94.4	94.7			
	0	97.1	94	96	102	112	4030	3510	165	93.3	93.6			
	10	96.1	95	97	102	112	4410	3850	165	91.9	92.3			
16000	-30	95.3	93	94	101	111	3310	2870	164	94.9	92.6			
	-20	97.2	92	94	101	111	3450	3000	164	95.4	94.4			
	-10	98.0	92	94	101	111	3640	3160	164	94.4	94.7			
	0	97.1	93	95	101	111	3880	3390	164	93.3	93.6			
	10	96.1	94	96	101	111	4250	3710	164	91.9	92.3			
15200	-30	95.3	90	92	98	110	3060	2620	163	94.9	92.6	107	2870	2500
	-20	97.2	90	91	98	109	3180	2740	163	95.4	94.4	107	2970	2590
	-10	98.0	90	91	98	109	3320	2880	163	94.4	94.7	107	3070	2670
	0	97.1	90	92	98	109	3530	3080	163	93.3	93.6	107	3170	2760
	10	96.1	91	93	98	109	3850	3360	163	92.0	92.3	107	3280	2860
14500	-30	95.3	91	91	96	108	3040	2520	162	94.9	92.6	105	2740	2380
	-20	97.2	90	90	96	108	3150	2620	162	95.4	94.4	105	2830	2470
	-10	98.0	89	89	96	107	3220	2680	162	94.4	94.7	105	2920	2550
	0	97.1	87	89	96	107	3260	2830	162	93.3	93.6	105	3010	2630
	10	96.1	88	90	96	106	3520	3070	162	92.0	92.3	105	3110	2710
13500	-30	95.3	91	91	92	105	3000	2500	160	94.8	92.6	101	2560	2230
	-20	97.2	91	91	92	105	3110	2600	160	95.4	94.4	101	2640	2300
	-10	98.0	90	90	92	105	3180	2650	160	94.4	94.7	101	2720	2380
	0	97.1	88	88	92	104	3190	2660	160	93.3	93.6	101	2800	2450
	10	96.1	85	86	92	104	3120	2710	160	92.0	92.3	101	2880	2520
12500	-30	95.3	92	92	92	106	2980	2500	159	94.8	92.6	98	2390	2080
	-20	97.2	91	91	92	106	3090	2590	159	95.4	94.4	98	2460	2150
	-10	98.0	90	90	91	104	3150	2640	159	94.4	94.7	98	2530	2210
	0	97.1	88	88	89	102	3150	2640	159	93.3	93.6	98	2600	2280
	10	96.1	85	85	89	101	3080	2570	159	92.0	92.3	98	2680	2340
11500	-30	95.3	92	92	94	108	2990	2510	158	94.8	92.6	94	2230	1940
	-20	97.2	92	92	94	108	3090	2610	158	95.4	94.4	94	2290	2000
	-10	98.0	91	91	92	106	3150	2650	158	94.4	94.7	94	2350	2050
	0	97.1	89	89	90	104	3140	2640	158	93.3	93.6	94	2420	2110
	10	96.1	86	86	86	100	3050	2560	158	92.0	92.3	94	2480	2170
10500	-30	95.3	93	93	95	110	3040	2550	157	94.8	92.6	90	2070	1800
	-20	97.2	93	93	95	110	3140	2650	157	95.4	94.4	90	2120	1850
	-10	98.0	92	92	94	109	3180	2680	157	94.4	94.7	90	2180	1900
	0	97.1	90	90	91	106	3160	2660	157	93.3	93.6	90	2240	1950
	10	96.1	86	86	88	102	3050	2560	157	92.0	92.3	90	2290	2000

Figure 7-18. Takeoff and Landing (Sheet 6 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15° **PRESSURE ALTITUDE 6000 FEET**
LANDING - FLAPS FULL **ANTI-ICE SYSTEMS ON**

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	97.3	93	95	102	112	3520	3060	164	96.3	94.7			
	-20	98.7	93	95	102	112	3690	3210	164	95.4	95.7			
	-10	98.0	94	95	102	112	3970	3470	164	94.4	94.6			
	0	97.1	94	96	102	112	4300	3760	164	93.3	93.5			
	10	96.1	96	97	102	112	4740	4150	164	91.9	92.3			
16000	-30	97.3	92	94	101	112	3400	2960	163	96.3	94.7			
	-20	98.7	92	94	101	111	3560	3100	163	95.4	95.7			
	-10	98.0	93	94	101	111	3830	3330	163	94.4	94.6			
	0	97.1	93	95	101	111	4150	3620	163	93.3	93.5			
	10	96.1	95	96	101	111	4570	3990	163	91.9	92.3			
15200	-30	97.3	91	91	98	110	3210	2710	162	96.3	94.7	107	2970	2590
	-20	98.7	90	91	98	110	3320	2830	162	95.4	95.7	107	3080	2680
	-10	98.0	90	91	98	109	3490	3040	162	94.4	94.6	107	3180	2770
	0	97.1	90	92	98	109	3760	3280	162	93.3	93.5	107	3290	2870
	10	96.1	92	93	98	109	4130	3610	162	91.9	92.3	107	3400	2960
14500	-30	97.3	91	91	96	108	3180	2650	161	96.3	94.7	105	2830	2470
	-20	98.7	90	90	96	108	3290	2740	161	95.4	95.7	105	2930	2550
	-10	98.0	88	89	96	107	3290	2790	161	94.4	94.6	105	3020	2640
	0	97.1	88	89	96	107	3450	3000	161	93.3	93.5	105	3120	2720
	10	96.1	89	90	96	106	3770	3290	161	92.0	92.3	105	3220	2810
13500	-30	97.3	91	91	92	105	3150	2630	159	96.3	94.7	101	2640	2300
	-20	98.7	91	91	92	105	3260	2720	159	95.4	95.7	101	2730	2380
	-10	98.0	89	89	92	105	3250	2710	159	94.4	94.6	101	2810	2460
	0	97.1	86	86	92	104	3210	2680	159	93.3	93.5	101	2900	2530
	10	96.1	85	86	92	103	3310	2880	159	92.0	92.3	101	2980	2610
12500	-30	97.3	92	92	93	107	3120	2620	158	96.3	94.7	98	2460	2150
	-20	98.7	91	91	93	106	3230	2710	158	95.4	95.7	98	2540	2210
	-10	98.0	89	89	90	103	3210	2700	158	94.4	94.6	98	2610	2280
	0	97.1	86	86	89	101	3170	2650	158	93.3	93.5	98	2690	2350
	10	96.1	83	83	89	101	3080	2570	158	92.0	92.3	98	2760	2420
11500	-30	97.3	93	93	94	109	3140	2640	156	96.3	94.7	94	2290	2000
	-20	98.7	92	92	94	108	3230	2730	156	95.4	95.7	94	2360	2060
	-10	98.0	90	90	91	105	3200	2700	156	94.4	94.6	94	2430	2120
	0	97.1	87	87	88	102	3150	2640	156	93.3	93.5	94	2490	2180
	10	96.1	84	84	85	98	3040	2550	156	92.0	92.3	94	2560	2240
10500	-30	97.3	94	94	96	111	3180	2680	155	96.3	94.7	90	2130	1850
	-20	98.7	93	93	96	110	3280	2770	155	95.4	95.7	90	2180	1900
	-10	98.0	91	91	93	107	3220	2730	155	94.4	94.6	90	2240	1960
	0	97.1	88	88	89	104	3150	2660	155	93.3	93.5	90	2300	2010
	10	96.1	84	84	85	99	3030	2550	155	92.0	92.3	90	2360	2060

Figure 7-18. Takeoff and Landing (Sheet 7 of 8)

TAKEOFF AND LANDING

TAKEOFF - FLAPS 15°
LANDING - FLAPS FULL

PRESSURE ALTITUDE 7000 FEET
ANTI-ICE SYSTEMS ON

		TAKEOFF							CLIMB			LANDING		
WT	AMB. TEMP	FAN	V1 = KIAS		VR	V2	FIELD LENGTH - FT		VENR	S.E. FAN	M.E. FAN	VREF	DISTANCE FEET	
LBS	DEG C	PERCENT RPM	ZERO WIND	20 KT WIND	KIAS	KIAS	ZERO WIND	20 KT WIND	KIAS	PERCENT RPM	PERCENT RPM	KIAS	ZERO WIND	20 KT WIND
16300	-30	99.0	93	95	102	112	3710	3220	163	96.3	96.6			
	-20	98.7	94	95	102	112	3940	3440	163	95.3	95.6			
	-10	98.0	94	96	102	112	4270	3720	163	94.4	94.6			
	0	97.1	95	97	102	112	4630	4050	163	93.3	93.5			
	10	96.1	96	98	102	112	5100	4470	163	91.9	92.3			
16000	-30	99.0	92	94	101	111	3580	3110	162	96.3	96.6			
	-20	98.7	92	94	101	111	3810	3310	162	95.4	95.6			
	-10	98.0	93	95	101	111	4110	3590	162	94.4	94.6			
	0	97.1	94	96	101	111	4460	3890	162	93.3	93.5			
	10	96.1	95	97	101	111	4920	4300	162	91.9	92.3			
15200	-30	99.0	90	91	98	109	3290	2840	161	96.3	96.6	107	3080	2680
	-20	98.7	90	91	98	109	3470	3010	161	95.4	95.6	107	3190	2780
	-10	98.0	90	92	98	109	3730	3250	161	94.4	94.6	107	3300	2870
	0	97.1	91	93	98	109	4040	3520	161	93.3	93.5	107	3410	2970
	10	96.1	92	94	98	109	4440	3880	161	91.9	92.3	107	3530	3080
14500	-30	99.0	90	90	96	108	3260	2710	160	96.3	96.6	105	2930	2550
	-20	98.7	88	89	96	107	3300	2770	160	95.4	95.6	105	3030	2640
	-10	98.0	87	89	96	107	3420	2980	160	94.4	94.6	105	3130	2730
	0	97.1	88	90	96	106	3690	3210	160	93.3	93.5	105	3230	2820
	10	96.1	89	91	96	106	4050	3530	160	91.9	92.3	105	3340	2920
13500	-30	99.0	90	90	92	105	3210	2680	158	96.3	96.6	101	2730	2380
	-20	98.7	89	89	92	105	3260	2730	158	95.4	95.6	101	2820	2460
	-10	98.0	87	87	92	104	3250	2710	158	94.4	94.6	101	2900	2540
	0	97.1	84	86	92	104	3250	2830	158	93.3	93.5	101	2990	2620
	10	96.1	85	87	92	103	3540	3080	158	92.0	92.3	101	3090	2700
12500	-30	99.0	91	91	92	105	3190	2670	156	96.4	96.6	98	2540	2220
	-20	98.7	89	89	90	104	3220	2710	156	95.4	95.6	98	2620	2290
	-10	98.0	87	87	89	102	3200	2680	156	94.4	94.6	98	2700	2360
	0	97.1	84	84	89	101	3170	2650	156	93.3	93.5	98	2770	2430
	10	96.1	81	83	88	100	3090	2700	156	92.0	92.3	98	2850	2500
11500	-30	99.0	92	92	93	107	3190	2680	155	96.4	96.6	94	2360	2060
	-20	98.7	90	90	92	105	3220	2710	155	95.4	95.6	94	2430	2120
	-10	98.0	88	88	89	102	3180	2670	155	94.4	94.6	94	2500	2190
	0	97.1	85	85	86	99	3140	2630	155	93.3	93.5	94	2570	2250
	10	96.1	82	82	85	97	3040	2550	155	92.0	92.3	94	2640	2310
10500	-30	99.0	92	92	95	110	3220	2730	154	96.4	96.6	90	2190	1900
	-20	98.7	91	91	93	108	3250	2740	154	95.4	95.6	90	2250	1960
	-10	98.0	88	88	90	104	3190	2700	154	94.4	94.6	90	2310	2020
	0	97.1	86	86	87	101	3120	2640	154	93.3	93.5	90	2370	2070
	10	96.1	82	82	83	96	3010	2540	154	92.0	92.3	90	2430	2130

Figure 7-18. Takeoff and Landing (Sheet 8 of 8)

THRUST REVERSER

The thrust reverser system is used to provide an additional decelerating force during ground operation. The thrust reverser can be used for normal landings, slick runways, no flap landings, in the case of brake failure or during rejected takeoffs. The thrust reverser performance is not to be used to supersede runway length requirements published in Section IV of the airplane flight manual.

The dry hard surface field lengths can be adjusted for cases with thrust reversers deployed on precipitation covered runways by using the following tabulated data. Corrections for takeoff and landing field lengths are presented for wet concrete and ice.

The distances for precipitation covered runways are based on the thrust reversers being operated in accordance with the procedures outlined in the airplane flight manual and also in this manual.

Refer to the airplane flight manual for limitations and procedures for thrust reverser operation.

THRUST REVERSER - TAKEOFF

PRECIPITATION COVERED RUNWAYS

TAKEOFF FIELD LENGTH		
DRY, HARD SURFACE WITHOUT THRUST REVERSER	WET CONCRETE WITH THRUST REVERSER	ICE WITH THRUST REVERSER
1400	1440	2360
1600	1800	2740
1800	2110	3080
2000	2410	3420
2200	2710	3755
2400	2975	4050
2600	3240	4335
2800	3490	4595
3000	3720	4830
* 3200	3935	4965
3400	4140	5230
3600	4325	5400
3800	4500	5560
4000	4665	5710
4200	4850	5890
4400	5020	6060
4600	5180	6220
4800	5360	6400
5000	5520	6560
5200	5710	6750
5400	5880	6920
5600	6070	7110
5800	6245	7285
6000	6420	7460
6200	6620	7660
6400	6810	7850
6600	7000	8040
6800	7190	8230
7000	7380	8420
7200	7570	8610
7400	7770	8810
7600	7960	9000
7800	8160	9200
8000	8350	9390

* EXAMPLE:

TAKEOFF FIELD LENGHT - FEET

DRY, HARD SURFACE WITHOUT THRUST REVERSER	3200
WET CONCRETE WITH THRUST REVERSER	3935
ICE WITH THRUST REVERSER	4965

Figure 7-19. Thrust Reverser - Takeoff (Sheet 1 of 2)

THRUST REVERSER - LANDING

PRECIPITATION COVERED RUNWAYS

LANDING FIELD LENGTH		
DRY, HARD SURFACE WITHOUT THRUST REVERSER	WET CONCRETE WITH THRUST REVERSER	ICE WITH THRUST REVERSER
1800	1820	2410
2000	2070	2865
2200	2290	3175
* 2400	2495	3410
2600	2685	3630
2800	2865	3820
3000	3040	3990
3200	3220	4150
3400	3400	4310
3600	3600	4460
3800	3800	4610
4000	4000	4760

* EXAMPLE:

LANDING FIELD LENGTH - FEET

DRY, HARD SURFACE WITHOUT THRUST REVERSER	2400
WET CONCRETE WITH THRUST REVERSER	2495
ICE WITH THRUST REVERSER	3410

Figure 7-19. Thrust Reverser - Landing(Sheet 2 of 2)

CLIMB

Multiengine climb performance is presented in tabulated form on the following pages. The climb presented is based on 250 KIAS/0.62 INDICATED MACH.

This performance is based on maximum continuous thrust setting on both engines (refer to the Multiengine Normal Climb thrust setting chart, Figure 7-6), gear and flaps up, speedbrakes retracted and anti-ice systems OFF. The performance is also presented for anti-ice systems ON.

The time, distance, fuel and rate-of-climb used to any given altitude is based on the climb starting at sea level. If the climb is initiated at some other altitude, it is necessary to go into the data twice, once at the initial altitude and once at the final altitude. The difference in time, distance and fuel between these two altitudes provides the proper values for the climb. The data allows for fuel burnoff in the climb; therefore, the weight presented is at the start of the climb.

The climb data for the conditions requiring a step climb are based on climbing direct to the highest obtainable altitude as shown in the step climb weight table, cruising at the altitude until the desired weight is achieved, and then climbing to the desired altitude or the next step altitude per the step climb weight table.

MULTI-ENGINE CLIMB

250 KIAS/0.62 INDICATED MACH

TIME, DISTANCE, FUEL, AND RATE OF CLIMB — ANTI-ICE SYSTEMS OFF

T.O. WEIGHT	16300	15500	14500	13500	12500	16300	15500	14500	13500	12500	16300	15500	14500	13500	12500	16300	15500	14500	13500	12500
PRESSURE ALTITUDE	5000 FEET ISA = 5°C = 41°F					10000 FEET ISA = - 5°C = 23°F					15000 FEET ISA = -15°C = 6°F					17000 FEET ISA = -19°C = - 2°F				
ISA +10°C MIN	2	2	2	2	2	4	4	4	3	3	6	6	5	5	5	7	7	6	6	5
NM	7	6	6	5	5	16	15	14	12	11	27	25	23	21	20	32	30	28	26	23
LB	80	76	70	65	59	164	155	143	132	121	253	238	220	203	186	290	273	252	232	212
R/C	2891	3068	3314	3595	3918	2494	2652	2872	3122	3409	2131	2272	2468	2690	2944	1975	2108	2293	2503	2743
ISA MIN	2	2	2	2	1	3	3	3	3	3	5	5	5	4	4	6	6	5	5	4
NM	5	5	5	4	4	12	12	11	10	9	21	20	19	17	16	25	24	22	20	18
LB	71	67	62	57	53	145	136	127	117	107	221	208	193	178	163	252	238	220	203	186
R/C	3482	3690	3980	4310	4691	3101	3291	3555	3857	4203	2707	2878	3117	3388	3699	2536	2699	2926	3183	3479
ISA -10°C MIN	2	2	2	1	1	3	3	3	2	2	4	4	4	4	3	5	5	4	4	4
NM	5	4	4	4	3	10	10	9	8	8	17	16	15	14	13	21	19	18	17	15
LB	65	61	57	53	49	131	124	115	106	98	198	187	174	160	147	226	213	197	182	168
R/C	4159	4403	4743	5131	5578	3774	4000	4314	4673	5085	3305	3508	3791	4114	4484	3088	3281	3549	3854	4204
PRESSURE ALTITUDE	19000 FEET ISA = -23°C = - 9°F					21000 FEET ISA = -27°C = -16°F					23000 FEET ISA = -31°C = -23°F					25000 FEET ISA = -35°C = -30°F				
ISA +10°C MIN	8	8	7	7	6	9	9	8	8	7	11	10	9	9	8	12	11	11	10	9
NM	38	36	33	30	28	45	42	39	35	32	52	49	45	41	38	61	57	53	48	44
LB	328	308	285	262	240	368	346	319	293	268	411	386	356	327	299	458	429	395	362	331
R/C	1820	1946	2121	2319	2545	1671	1790	1955	2142	2355	1505	1616	1770	1944	2142	1329	1432	1574	1735	1917
ISA MIN	7	6	6	6	5	8	7	7	6	6	9	8	8	7	6	10	9	9	8	7
NM	30	28	26	24	22	35	33	30	28	25	41	38	35	32	29	47	44	41	37	34
LB	284	268	248	228	210	318	299	277	255	234	353	332	307	283	259	391	368	339	312	286
R/C	2362	2518	2733	2977	3257	2174	2320	2523	2753	3016	1955	2090	2278	2491	2734	1726	1851	2023	2218	2441
ISA -10°C MIN	6	5	5	5	4	6	6	6	5	5	7	7	6	6	6	8	8	7	7	6
NM	24	23	21	19	18	28	27	25	23	21	33	31	29	26	24	38	36	33	31	28
LB	254	239	222	205	188	283	267	247	228	209	314	296	274	252	232	346	326	302	278	255
R/C	2864	3046	3299	3587	3917	2610	2780	3016	3284	3591	2342	2498	2716	2963	3245	2054	2197	2395	2619	2875
PRESSURE ALTITUDE	27000 FEET ISA = -38°C = -37°F					29000 FEET ISA = -42°C = -44°F					31000 FEET ISA = -46°C = -52°F					33000 FEET ISA = -50°C = -59°F				
ISA +10°C MIN	14	13	12	11	10	15	14	13	12	11	17	16	14	13	12	18	17	16	14	13
NM	71	66	61	55	50	80	74	68	62	56	89	83	75	69	62	98	91	83	76	69
LB	505	473	435	398	363	547	512	470	430	392	586	548	502	459	418	627	584	535	488	444
R/C	1293	1398	1544	1707	1893	1434	1557	1726	1916	2131	1346	1468	1636	1824	2037	1223	1344	1508	1692	1901
ISA MIN	11	10	10	9	8	12	11	10	10	9	13	12	11	11	10	15	14	13	12	11
NM	54	51	47	43	39	61	58	53	48	44	69	64	59	54	49	77	71	65	60	54
LB	430	403	372	342	313	464	436	401	369	337	498	467	430	394	360	532	498	458	419	383
R/C	1653	1778	1951	2147	2370	1776	1918	2114	2334	2585	1621	1759	1949	2163	2405	1463	1597	1782	1989	2223
ISA -10°C MIN	9	9	8	7	7	10	10	9	8	8	11	11	10	9	8	12	12	11	10	9
NM	44	42	38	35	32	50	47	43	40	36	56	53	48	44	40	63	59	54	49	45
LB	380	358	330	304	279	411	386	356	328	300	440	413	381	350	320	470	441	406	373	341
R/C	1956	2098	2295	2517	2772	2088	2248	2468	2716	2999	1914	2069	2283	2523	2796	1723	1873	2079	2310	2572
PRESSURE ALTITUDE	35000 FEET ISA = -54°C = -66°F					37000 FEET ISA = -57°C = -70°F					39000 FEET ISA = -57°C = -70°F					41000 FEET ISA = -57°C = -70°F				
ISA +10°C MIN	20	19	17	15	14	22	20	19	17	15	25	23	21	19	17	29	26	23	21	19
NM	109	101	92	83	75	122	113	102	92	83	138	127	114	103	92	161	146	130	116	103
LB	668	622	568	518	470	714	663	604	549	498	767	709	644	583	527	834	765	690	622	560
R/C	1080	1198	1359	1538	1740	883	994	1146	1315	1504	663	767	909	1066	1241	474	575	712	863	1031
ISA MIN	16	15	14	13	12	18	17	15	14	13	20	19	17	15	14	23	21	19	17	15
NM	85	79	72	66	60	96	89	81	73	66	109	100	91	82	74	126	115	103	92	83
LB	568	531	487	445	406	607	566	518	473	430	652	606	552	502	456	706	652	591	535	484
R/C	1297	1428	1608	1808	2035	1070	1194	1362	1550	1761	824	939	1096	1270	1465	615	726	877	1044	1230
ISA -10°C MIN	14	13	12	11	10	15	14	13	12	11	17	16	14	13	12	19	18	16	15	13
NM	70	65	60	55	50	79	73	67	61	55	89	82	75	68	61	103	94	85	77	69
LB	501	470	432	396	361	535	500	459	420	383	574	535	489	446	406	619	574	523	475	431
R/C	1529	1674	1873	2096	2348	1273	1410	1596	1804	2038	999	1125	1298	1490	1705	768	890	1056	1239	1444

PRESSURE ALTITUDE	43000 FEET ISA = -57°C = -70°F					45000 FEET ISA = -57°C = -70°F				
ISA +10°C MIN	34	30	27	24	21	46	38	32	27	24
NM	195	172	150	132	116	264	217	180	154	134
LB	926	837	745	666	596	1096	947	819	721	638
R/C	294	393	526	672	834	114	209	338	480	637
ISA MIN	27	24	22	19	17	34	30	25	22	20
NM	150	135	119	105	94	192	165	141	123	107
LB	776	709	636	573	515	885	788	694	617	551
R/C	413	522	668	829	1007	214	319	461	617	789
ISA -10°C MIN	22	20	18	16	15	27	24	21	19	17
NM	121	110	98	87	78	150	132	115	101	89
LB	675	621	561	508	458	755	683	609	545	489
R/C	545	664	824	1000	1195	328	443	599	769	957

WIND EFFECT ON CLIMB DISTANCE - NM
(SUBTRACT FOR HEADWIND, ADD FOR TAILWIND)

CLIMB TIME (MIN)	WIND 25KTS	50KTS	100KTS
5	2	4	8
10	4	8	16
15	6	12	25
20	8	16	33
25	10	20	41
30	12	25	50

* INDICATES STEP CLIMB REQUIRED
NOTE: STEP CLIMB DATA INCLUDES TIME, DISTANCE AND FUEL USED IN CRUISE PORTION. BASED ON MAXIMUM CRUISE THRUST.

CRUISE CLIMB SPEED - KIAS

PRESSURE ALTITUDE-FEET									
0	5000	10000	15000	20000	25000	30000	35000	40000	45000
250	250	250	250	250	250	231	206	183	163

Figure 7-20 Multiengine Climb Anti-Ice Off

MULTI-ENGINE CLIMB

250 KIAS/0.62 INDICATED MACH

TIME, DISTANCE, FUEL, AND RATE OF CLIMB — **ANTI-ICE SYSTEMS ON**

T.O. WEIGHT		16300	15500	14500	13500	12500	16300	15500	14500	13500	12500	16300	15500	14500	13500	12500	16300	15500	14500	13500	12500
PRESSURE ALTITUDE		5000 FEET ISA = 5°C = 41°F					10000 FEET ISA = - 5°C = 23°F					15000 FEET ISA = -15°C = 6°F					17000 FEET ISA = -19°C = - 2°F				
ISA +10°C	MIN	2	2	2	2	2	4	4	4	4	3	7	7	6	6	5	8	8	7	7	6
	NM	8	7	7	6	5	18	17	15	14	13	31	29	27	24	22	37	35	32	29	27
	LB	88	83	77	71	65	182	171	158	146	134	282	265	245	225	206	324	304	281	258	236
	R/C	2545	2704	2926	3178	3467	2205	2348	2547	2772	3031	1834	1960	2134	2331	2557	1676	1794	1957	2141	2352
ISA	MIN	2	2	2	2	2	4	4	3	3	3	6	5	5	5	4	7	6	6	5	5
	NM	6	6	5	5	4	14	13	12	11	10	24	22	21	19	17	29	27	25	23	21
	LB	77	73	67	62	57	157	148	137	127	116	241	227	210	194	178	276	260	240	221	203
	R/C	3148	3339	3605	3908	4257	2768	2941	3182	3456	3770	2389	2544	2759	3004	3285	2235	2383	2588	2820	3087
ISA -10°C	MIN	2	2	2	2	1	3	3	3	3	2	5	4	4	4	4	5	5	5	4	4
	NM	5	5	4	4	3	11	11	10	9	8	19	18	16	15	14	22	21	20	18	16
	LB	70	66	61	57	52	141	133	123	114	105	213	201	186	172	158	243	229	212	196	180
	R/C	3808	4033	4348	4707	5120	3438	3646	3937	4267	4647	3037	3227	3490	3790	4135	2865	3046	3298	3584	3913
PRESSURE ALTITUDE		19000 FEET ISA = -23°C = - 9°F					21000 FEET ISA = -27°C = -16°F					23000 FEET ISA = -31°C = -23°F					25000 FEET ISA = -35°C = -30°F				
ISA +10°C	MIN	9	9	8	8	7	11	10	9	9	8	12	12	11	10	9	14	13	12	11	10
	NM	44	41	38	35	32	52	49	45	41	37	61	57	53	48	44	72	67	62	56	51
	LB	368	346	319	292	267	416	390	359	329	300	467	437	402	368	336	523	489	449	410	374
	R/C	1511	1621	1774	1945	2142	1374	1478	1621	1782	1966	1231	1328	1461	1612	1783	1077	1167	1290	1429	1587
ISA	MIN	8	7	7	6	6	9	8	7	7	6	10	9	8	8	7	11	10	9	9	8
	NM	34	32	29	27	24	39	37	34	31	28	46	43	39	36	33	53	49	45	42	38
	LB	312	293	271	249	229	349	328	303	279	255	388	364	336	309	283	429	403	372	341	312
	R/C	2088	2229	2424	2645	2899	1930	2063	2248	2457	2697	1775	1901	2076	2274	2499	1599	1717	1880	2064	2275
ISA -10°C	MIN	6	6	5	5	5	7	7	6	6	5	8	7	7	6	6	9	8	8	7	7
	NM	26	25	23	21	19	31	29	27	24	22	35	33	31	28	26	41	38	35	33	30
	LB	273	257	238	219	201	303	286	265	244	224	336	316	293	270	247	370	348	322	297	272
	R/C	2703	2877	3118	3392	3707	2491	2654	2881	3139	3434	2271	2424	2636	2877	3153	2046	2189	2386	2609	2865
PRESSURE ALTITUDE		27000 FEET ISA = -38°C = -37°F					29000 FEET ISA = -42°C = -44°F					31000 FEET ISA = -46°C = -52°F					33000 FEET ISA = -50°C = -59°F				
ISA +10°C	MIN	16	15	14	13	12	18	17	15	14	13	19	18	16	15	14	21	19	18	16	15
	NM	84	78	71	65	59	94	87	80	72	66	104	96	88	80	72	114	105	96	87	78
	LB	580	541	496	453	412	627	585	535	488	444	671	625	571	520	473	713	664	606	551	500
	R/C	1076	1170	1299	1444	1608	1295	1410	1568	1745	1947	1268	1386	1547	1728	1933	1210	1328	1491	1673	1879
ISA	MIN	12	11	10	10	9	13	12	11	11	10	14	14	12	11	10	16	15	14	12	11
	NM	61	57	52	48	43	68	63	58	53	48	75	70	64	59	53	83	77	70	64	58
	LB	471	442	407	374	341	508	476	438	402	367	543	508	467	428	390	579	541	497	455	414
	R/C	1560	1680	1846	2034	2247	1749	1890	2083	2301	2549	1642	1780	1971	2186	2430	1510	1647	1834	2044	2283
ISA -10°C	MIN	10	9	9	8	7	11	10	9	9	8	12	11	10	9	9	13	12	11	10	9
	NM	47	44	41	37	34	53	49	45	42	38	58	55	50	46	42	65	61	56	51	46
	LB	405	381	352	324	297	436	410	378	348	319	467	438	404	371	340	499	468	431	395	361
	R/C	1987	2131	2330	2555	2812	2154	2317	2542	2795	3085	1948	2105	2321	2563	2839	1730	1880	2086	2318	2580
PRESSURE ALTITUDE		35000 FEET ISA = -54°C = -66°F					37000 FEET ISA = -57°C = -70°F					39000 FEET ISA = -57°C = -70°F					41000 FEET ISA = -57°C = -70°F				
ISA +10°C	MIN	23	21	19	17	16	25	23	21	19	17	27	25	23	21	19	31	28	25	23	20
	NM	124	115	104	94	85	137	126	114	103	93	153	140	126	113	102	174	158	141	126	112
	LB	757	703	640	582	528	804	745	677	615	556	859	794	719	650	587	928	852	767	691	622
	R/C	1098	1216	1377	1557	1759	907	1019	1172	1341	1532	691	796	939	1097	1273	501	603	740	892	1061
ISA	MIN	17	16	15	13	12	19	18	16	15	13	21	20	18	16	15	24	22	20	18	16
	NM	91	85	77	70	64	101	94	85	78	70	114	105	95	86	78	132	120	108	97	87
	LB	616	575	527	482	439	657	612	560	510	464	705	655	596	542	492	764	705	639	578	523
	R/C	1334	1467	1648	1851	2081	1083	1207	1376	1564	1776	825	940	1096	1269	1463	603	714	863	1028	1212
ISA -10°C	MIN	14	13	12	11	10	16	15	13	12	11	17	16	15	13	12	20	18	17	15	14
	NM	72	67	62	56	51	81	75	69	62	57	92	85	77	70	63	107	98	88	79	71
	LB	532	498	458	420	383	569	531	487	446	406	611	569	520	475	431	662	614	558	507	459
	R/C	1509	1652	1850	2070	2320	1229	1363	1546	1750	1979	947	1071	1239	1426	1636	707	826	987	1164	1363

CRUISE CLIMB SPEED - KIAS

PRESSURE ALTITUDE-FEET									
0	5000	10000	15000	20000	25000	30000	35000	40000	41000
250	250	250	250	250	250	231	206	183	179

WIND EFFECT ON CLIMB DISTANCE - NM
(SUBTRACT FOR HEADWIND, ADD FOR TAILWIND)

CLIMB TIME (MIN)	WIND 25KTS	50KTS	100KTS
5	2	4	8
10	4	8	16
15	6	12	25
20	8	16	33
25	10	20	41
30	12	25	50

Figure 7-20 Multiengine Climb Anti-Ice On

CRUISE

Specific performance data are presented on the following pages for various combinations of fan speeds, weights, temperature, altitudes and winds to enable the calculation of the cruise portion of a range profile.

The various fan speeds presented provide the specific ranges between maximum cruise thrust (maximum TAS) and the approximate maximum range thrust. It should be noted that reducing thrust to maintain a constant indicated airspeed as the airplane weight decreases during cruise results in a significant increase in range. The best range, however, results from decreasing thrust to fly a constantly decreasing airspeed as airplane weight decreases per the values shown in the tabulated data.

When the anti-ice systems are ON, increase the fuel flows and decrease the specific ranges that are presented for each altitude by 6 percent. The cruise speeds will remain the same for a given fan RPM (N_1). The maximum allowable fan speeds with anti-ice systems ON are presented on each chart for each altitude. Only fan speeds equal to or lower than these values can be used.

The one engine specific range data is presented for use in the event of an enroute engine failure.

CRUISE
5000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	79.4	15	25	1761	262	.43	284	10.4	13.3	16.1	19.0	21.8
	(1) 78.1	5	15	1721	262	.43	279	10.4	13.3	16.2	19.1	22.0
	76.7	-5	4	1684	262	.43	274	10.3	13.3	16.3	19.2	22.2
	75.0	15	23	1550	239	.39	259	10.3	13.5	16.7	20.0	23.2
	75.0	5	14	1573	245	.41	262	10.3	13.5	16.6	19.8	23.0
	75.0	-5	4	1598	252	.42	264	10.2	13.4	16.5	19.6	22.8
	71.0	15	22	1388	219	.36	238	9.9	13.5	17.1	20.7	24.3
	71.0	5	12	1406	225	.37	241	10.0	13.6	17.1	20.7	24.2
	71.0	-5	2	1425	232	.38	243	10.0	13.5	17.0	20.6	24.1
	67.0	15	21	1257	200	.33	218	9.4	13.3	17.3	21.3	25.3
	67.0	5	11	1267	206	.34	220	9.5	13.4	17.4	21.3	25.3
	67.0	-5	1	1277	212	.35	222	9.6	13.5	17.4	21.3	25.2
	63.0	15	20	1130	178	.30	194	8.4	12.8	17.2	21.6	26.1
	(2) 63.0	5	10	1139	185	.31	198	8.6	13.0	17.4	21.7	26.1
	63.0	-5	0	1149	191	.32	201	8.8	13.2	17.5	21.9	26.2
15000.	79.2	15	25	1747	262	.43	284	10.5	13.4	16.3	19.1	22.0
	(1) 77.8	5	15	1708	262	.43	279	10.5	13.4	16.3	19.3	22.2
	76.4	-5	4	1671	262	.43	274	10.4	13.4	16.4	19.4	22.4
	74.0	15	23	1508	236	.39	256	10.4	13.7	17.0	20.3	23.6
	74.0	5	13	1530	241	.40	258	10.3	13.6	16.8	20.1	23.4
	74.0	-5	3	1553	248	.41	260	10.3	13.5	16.8	20.0	23.2
	70.0	15	22	1356	217	.36	236	10.0	13.7	17.4	21.1	24.8
	70.0	5	12	1367	222	.37	237	10.1	13.7	17.4	21.0	24.7
	70.0	-5	2	1384	228	.38	240	10.1	13.7	17.3	20.9	24.5
	65.0	15	21	1194	193	.32	211	9.3	13.5	17.6	21.8	26.0
	65.0	5	11	1204	199	.33	213	9.4	13.6	17.7	21.9	26.0
	65.0	-5	1	1213	205	.34	215	9.5	13.6	17.7	21.9	26.0
	61.0	15	19	1072	172	.29	187	8.1	12.8	17.4	22.1	26.8
	(2) 61.0	5	10	1078	178	.30	190	8.4	13.0	17.6	22.3	26.9
	61.0	-5	0	1087	184	.31	193	8.6	13.2	17.8	22.4	27.0
14000.	78.9	15	25	1734	262	.43	284	10.6	13.5	16.4	19.3	22.1
	(1) 77.6	5	15	1697	262	.43	279	10.5	13.5	16.4	19.4	22.3
	76.2	-5	4	1659	262	.43	274	10.5	13.5	16.5	19.5	22.5
	74.0	15	23	1508	237	.39	258	10.4	13.8	17.1	20.4	23.7
	74.0	5	13	1530	243	.40	260	10.4	13.7	17.0	20.2	23.5
	74.0	-5	4	1553	250	.41	261	10.4	13.6	16.8	20.1	23.3
	69.0	15	22	1324	214	.36	233	10.1	13.8	17.6	21.4	25.2
	69.0	5	12	1334	220	.36	235	10.1	13.9	17.6	21.4	25.1
	69.0	-5	2	1345	225	.37	236	10.1	13.9	17.6	21.3	25.0
	64.0	15	20	1163	191	.32	208	9.3	13.6	17.9	22.2	26.5
	64.0	5	11	1173	197	.33	211	9.5	13.7	18.0	22.3	26.5
	64.0	-5	1	1181	203	.34	213	9.6	13.8	18.0	22.3	26.5
	59.0	15	19	1014	165	.28	180	7.9	12.8	17.7	22.6	27.6
	(2) 59.0	5	9	1022	171	.29	183	8.1	13.0	17.9	22.8	27.7
	59.0	-5	-1	1029	177	.30	186	8.3	13.2	18.1	22.9	27.8
13000.	78.7	15	25	1723	262	.43	284	10.7	13.6	16.5	19.4	22.3
	(1) 77.3	5	15	1686	262	.43	279	10.6	13.6	16.5	19.5	22.5
	75.9	-5	4	1648	262	.43	274	10.5	13.6	16.6	19.6	22.7
	73.0	15	23	1467	234	.39	255	10.5	14.0	17.4	20.8	24.2
	73.0	5	13	1488	239	.40	256	10.5	13.8	17.2	20.5	23.9
	73.0	-5	3	1510	246	.41	258	10.5	13.8	17.1	20.4	23.7
	67.0	15	21	1259	208	.35	227	10.1	14.0	18.0	22.0	25.9
	67.0	5	12	1269	213	.35	228	10.1	14.0	18.0	21.9	25.9
	67.0	-5	2	1279	218	.36	229	10.1	14.0	17.9	21.8	25.7
	62.0	15	20	1102	185	.31	201	9.2	13.7	18.3	22.8	27.3
	62.0	5	10	1109	190	.32	204	9.3	13.9	18.4	22.9	27.4
	62.0	-5	0	1119	196	.33	206	9.4	13.9	18.4	22.9	27.3
	57.0	15	19	956	157	.26	172	7.5	12.7	17.9	23.2	28.4
	(2) 57.0	5	9	966	164	.27	175	7.8	13.0	18.2	23.3	28.5
	57.0	-5	-1	972	170	.29	179	8.1	13.3	18.4	23.6	28.7
12000.	78.5	15	25	1713	262	.43	284	10.7	13.7	16.6	19.5	22.4
	(1) 77.1	5	15	1676	262	.43	279	10.7	13.7	16.6	19.6	22.6
	75.7	-5	4	1639	262	.43	274	10.6	13.7	16.7	19.8	22.8
	72.0	15	23	1427	231	.38	251	10.6	14.1	17.6	21.1	24.6
	72.0	5	13	1446	236	.39	252	10.5	14.0	17.4	20.9	24.4
	72.0	-5	3	1467	243	.40	254	10.5	13.9	17.3	20.7	24.1
	67.0	15	22	1260	210	.35	228	10.2	14.2	18.1	22.1	26.1
	67.0	5	12	1270	215	.36	230	10.2	14.2	18.1	22.1	26.0
	67.0	-5	2	1279	220	.37	231	10.2	14.2	18.1	22.0	25.9
	61.0	15	20	1076	184	.31	200	9.3	14.0	18.6	23.3	27.9
	61.0	5	10	1080	188	.31	202	9.4	14.0	18.7	23.3	27.9
	61.0	-5	0	1088	193	.32	203	9.5	14.1	18.7	23.3	27.9
	56.0	15	19	927	157	.26	170	7.6	13.0	18.4	23.8	29.2
	(2) 56.0	5	9	938	163	.27	175	8.0	13.3	18.6	23.9	29.3
	56.0	-5	-1	945	169	.28	178	8.2	13.5	18.8	24.1	29.4

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
15°C	5°C	-5°C
78.1	76.8	75.4
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 1 of 18)

CRUISE
10,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	87.4	5	20	2026	292	.53	340	11.9	14.3	16.8	19.3	21.7
	(1) 85.8	-5	9	1978	292	.53	334	11.8	14.4	16.9	19.4	21.9
	84.2	-15	-1	1932	292	.53	328	11.8	14.4	17.0	19.5	22.1
	82.0	5	16	1643	257	.47	301	12.2	15.3	18.3	21.3	24.4
	82.0	-5	7	1689	266	.48	305	12.1	15.1	18.0	21.0	24.0
	82.0	-15	-3	1769	278	.50	312	12.0	14.8	17.6	20.4	23.3
	77.0	5	14	1389	228	.41	267	12.0	15.6	19.2	22.8	26.4
	77.0	-5	4	1422	235	.43	271	12.0	15.5	19.0	22.6	26.1
	77.0	-15	-5	1462	245	.44	276	12.0	15.4	18.9	22.3	25.7
	72.0	5	12	1209	202	.37	238	11.4	15.5	19.7	23.8	27.9
	72.0	-5	2	1226	209	.38	241	11.5	15.6	19.7	23.8	27.8
	72.0	-15	-7	1243	216	.39	244	11.6	15.6	19.6	23.7	27.7
	67.0	5	10	1057	176	.32	207	10.1	14.8	19.6	24.3	29.0
	(2) 67.0	-5	1	1065	182	.33	210	10.4	15.1	19.7	24.4	29.1
	67.0	-15	-9	1075	189	.34	214	10.6	15.2	19.9	24.5	29.2
15000.	87.2	5	20	2015	292	.53	340	11.9	14.4	16.9	19.4	21.8
	(1) 85.6	-5	9	1968	292	.53	334	11.9	14.4	17.0	19.5	22.1
	84.0	-15	-1	1921	292	.53	328	11.8	14.5	17.1	19.7	22.3
	81.0	5	16	1591	253	.46	296	12.3	15.5	18.6	21.8	24.9
	81.0	-5	6	1633	261	.47	299	12.2	15.3	18.3	21.4	24.5
	81.0	-15	-3	1691	271	.49	304	12.1	15.0	18.0	20.9	23.9
	76.0	5	14	1351	225	.41	264	12.1	15.8	19.5	23.2	26.9
	76.0	-5	4	1374	232	.42	266	12.1	15.7	19.4	23.0	26.6
	76.0	-15	-6	1412	240	.43	270	12.1	15.6	19.2	22.7	26.2
	70.0	5	12	1143	195	.36	230	11.3	15.7	20.1	24.5	28.8
	70.0	-5	2	1158	202	.37	232	11.4	15.8	20.1	24.4	28.7
	70.0	-15	-8	1175	209	.38	236	11.6	15.8	20.1	24.3	28.6
	65.0	5	10	1005	170	.31	200	10.0	15.0	19.9	24.9	29.9
	(2) 65.0	-5	0	1012	176	.32	204	10.2	15.2	20.1	25.1	30.0
	65.0	-15	-9	1021	183	.33	207	10.5	15.4	20.3	25.2	30.1
14000.	87.1	5	20	2004	292	.53	340	12.0	14.5	17.0	19.5	22.0
	(1) 85.5	-5	9	1958	292	.53	334	11.9	14.5	17.1	19.6	22.2
	83.9	-15	-1	1911	292	.53	328	11.9	14.5	17.1	19.8	22.4
	81.0	5	16	1593	255	.46	298	12.4	15.6	18.7	21.8	25.0
	81.0	-5	6	1634	263	.47	301	12.3	15.4	18.4	21.5	24.5
	81.0	-15	-3	1693	273	.49	306	12.2	15.1	18.1	21.0	24.0
	75.0	5	14	1314	222	.40	261	12.2	16.0	19.8	23.6	27.4
	75.0	-5	4	1334	228	.41	262	12.1	15.9	19.6	23.4	27.1
	75.0	-15	-6	1363	236	.43	266	12.2	15.8	19.5	23.2	26.8
	69.0	5	12	1112	194	.35	228	11.5	16.0	20.5	24.9	29.4
	69.0	-5	2	1125	199	.36	230	11.5	16.0	20.4	24.9	29.3
	69.0	-15	-8	1140	206	.38	233	11.7	16.0	20.4	24.8	29.2
	63.0	5	10	953	165	.30	194	9.8	15.1	20.3	25.6	30.8
	(2) 63.0	-5	0	960	171	.31	197	10.1	15.3	20.5	25.7	31.0
	63.0	-15	-10	969	177	.32	201	10.4	15.6	20.7	25.9	31.0
13000.	86.9	5	20	1994	292	.53	340	12.0	14.5	17.1	19.6	22.1
	(1) 85.3	-5	9	1951	292	.53	334	12.0	14.6	17.1	19.7	22.2
	83.7	-15	-1	1902	292	.53	328	12.0	14.6	17.2	19.9	22.5
	80.0	5	16	1542	251	.45	293	12.5	15.8	19.0	22.3	25.5
	80.0	-5	6	1581	258	.47	296	12.4	15.6	18.7	21.9	25.0
	80.0	-15	-4	1626	267	.48	300	12.3	15.4	18.4	21.5	24.6
	74.0	5	13	1279	220	.40	258	12.3	16.2	20.1	24.0	28.0
	74.0	-5	4	1298	225	.41	259	12.2	16.1	20.0	23.8	27.7
	74.0	-15	-6	1320	232	.42	262	12.2	16.0	19.8	23.6	27.4
	67.0	5	11	1060	188	.34	221	11.5	16.2	20.9	25.6	30.3
	67.0	-5	1	1068	194	.35	223	11.6	16.2	20.9	25.6	30.3
	67.0	-15	-9	1076	199	.36	225	11.6	16.3	20.9	25.6	30.2
	61.0	5	10	901	159	.29	186	9.6	15.2	20.7	26.3	31.8
	(2) 61.0	-5	0	908	165	.30	190	9.9	15.4	21.0	26.5	32.0
	61.0	-15	-10	918	171	.31	194	10.2	15.7	21.1	26.6	32.0
12000.	86.8	5	20	1985	292	.53	340	12.1	14.6	17.1	19.7	22.2
	(1) 85.2	-5	9	1943	292	.53	334	12.0	14.6	17.2	19.8	22.3
	83.6	-15	-1	1893	292	.53	328	12.0	14.7	17.3	20.0	22.6
	79.0	5	16	1491	247	.45	288	12.6	16.0	19.3	22.7	26.1
	79.0	-5	6	1535	255	.46	293	12.6	15.8	19.1	22.3	25.6
	79.0	-15	-4	1573	262	.47	295	12.4	15.6	18.8	21.9	25.1
	72.0	5	13	1210	213	.39	250	12.4	16.5	20.6	24.8	28.9
	72.0	-5	3	1227	219	.40	252	12.4	16.5	20.5	24.6	28.7
	72.0	-15	-7	1244	224	.41	253	12.3	16.3	20.3	24.4	28.4
	66.0	5	11	1034	187	.34	220	11.6	16.4	21.2	26.1	30.9
	66.0	-5	1	1041	192	.35	222	11.7	16.5	21.3	26.1	30.9
	66.0	-15	-9	1050	197	.36	223	11.7	16.5	21.3	26.0	30.8
	59.0	5	9	853	153	.28	180	9.4	15.3	21.1	27.0	32.8
	(2) 59.0	-5	-1	859	159	.29	183	9.7	15.5	21.4	27.2	33.0
	59.0	-15	-10	868	165	.30	187	10.1	15.8	21.6	27.3	33.1

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
5°C	-5°C	-15°C
86.9	85.3	83.7
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 2 of 18)

CRUISE
15,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.		FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL: 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.		90.6	-5	12	1988	292	.58	366	13.4	15.9	18.4	20.9	23.4
	(1)	88.9	-15	1	1936	292	.58	359	13.4	16.0	18.6	21.1	23.7
		87.2	-25	-9	1895	292	.58	352	13.3	15.9	18.6	21.2	23.9
		85.0	-5	8	1588	257	.51	324	14.1	17.2	20.4	23.5	26.7
		85.0	-15	-1	1656	267	.53	330	13.9	16.9	19.9	22.9	25.9
		85.0	-25	-11	1731	278	.55	336	13.6	16.5	19.4	22.3	25.2
		80.0	-5	5	1301	224	.45	284	14.1	18.0	21.8	25.7	29.5
		80.0	-15	-4	1332	232	.46	287	14.1	17.8	21.6	25.3	29.1
		80.0	-25	-14	1403	245	.49	297	14.0	17.6	21.2	24.7	28.3
		75.0	-5	3	1104	195	.39	247	13.3	17.9	22.4	26.9	31.5
		75.0	-15	-7	1127	203	.41	252	13.5	17.9	22.4	26.8	31.2
		75.0	-25	-16	1156	211	.42	258	13.6	18.0	22.3	26.6	30.9
		71.0	-5	1	987	172	.35	219	12.0	17.1	22.2	27.2	32.3
	(2)	71.0	-15	-8	1000	180	.36	224	12.4	17.4	22.4	27.4	32.4
		71.0	-25	-18	1016	188	.38	229	12.8	17.7	22.6	27.5	32.4
15000.		90.4	-5	12	1977	292	.58	366	13.5	16.0	18.5	21.1	23.6
	(1)	88.7	-15	1	1925	292	.58	359	13.5	16.1	18.7	21.3	23.9
		87.0	-25	-9	1884	292	.58	352	13.4	16.0	18.7	21.3	24.0
		85.0	-5	8	1590	259	.51	326	14.2	17.3	20.5	23.6	26.8
		85.0	-15	-1	1658	268	.53	331	13.9	17.0	20.0	23.0	26.0
		85.0	-25	-11	1733	279	.55	337	13.7	16.6	19.5	22.3	25.2
		80.0	-5	5	1303	227	.45	287	14.3	18.2	22.0	25.8	29.7
		80.0	-15	-4	1338	235	.47	291	14.3	18.0	21.7	25.5	29.2
		80.0	-25	-14	1405	246	.49	299	14.2	17.7	21.3	24.9	28.4
		75.0	-5	3	1105	198	.40	251	13.7	18.2	22.7	27.3	31.8
		75.0	-15	-7	1127	206	.41	256	13.8	18.3	22.7	27.1	31.6
		75.0	-25	-16	1159	215	.43	262	13.9	18.3	22.6	26.9	31.2
		70.0	-5	1	961	172	.35	219	12.4	17.6	22.8	28.0	33.2
	(2)	70.0	-15	-9	973	180	.36	224	12.7	17.9	23.0	28.1	33.3
		70.0	-25	-18	989	187	.38	229	13.0	18.1	23.1	28.2	33.2
14000.		90.3	-5	12	1966	292	.58	366	13.5	16.1	18.6	21.2	23.7
	(1)	88.6	-15	1	1914	292	.58	359	13.5	16.2	18.8	21.4	24.0
		86.8	-25	-9	1874	292	.58	352	13.5	16.1	18.8	21.5	24.1
		84.0	-5	8	1527	254	.50	320	14.4	17.7	20.9	24.2	27.5
		84.0	-15	-2	1589	263	.52	325	14.2	17.3	20.5	23.6	26.7
		84.0	-25	-11	1660	274	.54	331	13.9	16.9	19.9	22.9	25.9
		79.0	-5	5	1263	224	.45	283	14.5	18.4	22.4	26.4	30.3
		79.0	-15	-5	1297	231	.46	287	14.4	18.3	22.1	26.0	29.8
		79.0	-25	-14	1342	241	.48	293	14.3	18.1	21.8	25.5	29.2
		73.0	-5	3	1046	192	.38	244	13.7	18.5	23.3	28.1	32.9
		73.0	-15	-7	1061	198	.40	247	13.9	18.6	23.3	28.0	32.7
		73.0	-25	-17	1081	205	.41	251	13.9	18.6	23.2	27.8	32.4
		68.0	-5	1	908	167	.34	212	12.3	17.8	23.3	28.8	34.3
	(2)	68.0	-15	-9	919	173	.35	216	12.6	18.0	23.5	28.9	34.4
		68.0	-25	-19	934	181	.36	221	12.9	18.3	23.6	29.0	34.3
13000.		90.1	-5	12	1956	292	.58	366	13.6	16.2	18.7	21.3	23.8
	(1)	88.4	-15	1	1904	292	.58	359	13.6	16.2	18.9	21.5	24.1
		86.7	-25	-9	1865	292	.58	352	13.5	16.2	18.9	21.6	24.3
		83.0	-5	8	1468	249	.49	314	14.6	18.0	21.4	24.8	28.2
		83.0	-15	-2	1527	258	.51	319	14.3	17.6	20.9	24.2	27.4
		83.0	-25	-12	1591	268	.53	324	14.1	17.2	20.4	23.5	26.7
		77.0	-5	4	1182	215	.43	272	14.6	18.8	23.0	27.3	31.5
		77.0	-15	-5	1213	222	.44	276	14.5	18.6	22.8	26.9	31.0
		77.0	-25	-15	1248	231	.46	280	14.5	18.5	22.5	26.5	30.5
		71.0	-5	2	990	186	.37	236	13.8	18.8	23.9	28.9	34.0
		71.0	-15	-8	1003	192	.38	239	13.8	18.8	23.8	28.8	33.8
		71.0	-25	-17	1019	198	.40	242	14.0	18.9	23.8	28.7	33.6
		65.0	-5	0	839	156	.31	199	11.8	17.7	23.7	29.6	35.6
	(2)	65.0	-15	-10	846	163	.33	203	12.2	18.1	24.0	29.9	35.8
		65.0	-25	-19	854	169	.34	207	12.5	18.3	24.2	30.0	35.9
12000.		90.0	-5	12	1946	292	.58	366	13.7	16.2	18.8	21.4	24.0
	(1)	88.3	-15	1	1895	292	.58	359	13.7	16.3	19.0	21.6	24.2
		86.6	-25	-9	1856	292	.58	352	13.6	16.3	19.0	21.7	24.4
		83.0	-5	8	1469	250	.50	316	14.7	18.1	21.5	24.9	28.3
		83.0	-15	-2	1528	260	.51	321	14.4	17.7	21.0	24.2	27.5
		83.0	-25	-12	1592	269	.53	326	14.2	17.3	20.5	23.6	26.7
		76.0	-5	4	1144	212	.42	268	14.7	19.1	23.5	27.8	32.2
		76.0	-15	-6	1173	219	.44	272	14.7	18.9	23.2	27.5	31.7
		76.0	-25	-15	1207	227	.45	276	14.6	18.7	22.9	27.0	31.2
		69.0	-5	2	935	180	.36	229	13.8	19.1	24.5	29.8	35.2
		69.0	-15	-8	947	186	.37	231	13.9	19.2	24.4	29.7	35.0
		69.0	-25	-18	962	192	.38	235	14.0	19.2	24.4	29.6	34.8
		63.0	-5	0	798	152	.31	194	11.8	18.0	24.3	30.6	36.8
	(2)	63.0	-15	-10	805	159	.32	198	12.1	18.4	24.6	30.8	37.0
		63.0	-25	-20	811	164	.33	201	12.5	18.6	24.8	30.9	37.1

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-5°C	-15°C	-25°C
88.8	88.6	86.8
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 3 of 18)

CRUISE
17,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	92.0	-9	9	1984	292	.60	377	14.0	16.5	19.0	21.5	24.1
	(1) 90.2	-19	-2	1939	292	.60	370	13.9	16.5	19.1	21.7	24.2
	88.4	-29	-12	1892	292	.60	363	13.9	16.5	19.2	21.8	24.5
	87.0	-9	6	1612	261	.54	338	14.8	17.9	21.0	24.1	27.2
	87.0	-19	-4	1690	271	.56	345	14.5	17.4	20.4	23.4	26.3
	87.0	-29	-13	1771	283	.58	351	14.2	17.0	19.8	22.6	25.5
	82.0	-9	2	1319	230	.47	299	15.1	18.9	22.7	26.5	30.3
	82.0	-19	-7	1372	239	.49	305	15.0	18.6	22.2	25.9	29.5
	82.0	-29	-17	1432	250	.52	312	14.8	18.3	21.8	25.3	28.8
	77.0	-9	0	1099	197	.41	258	14.4	18.9	23.5	28.0	32.6
	77.0	-19	-10	1127	206	.43	264	14.5	19.0	23.4	27.8	32.3
	77.0	-29	-20	1161	215	.45	271	14.7	19.0	23.3	27.6	31.9
	73.0	-9	-2	972	172	.36	226	13.0	18.1	23.3	28.4	33.5
	(2) 73.0	-19	-12	990	181	.38	233	13.5	18.5	23.6	28.6	33.7
	73.0	-29	-22	1012	190	.40	240	13.8	18.8	23.7	28.6	33.6
15000.	91.8	-9	9	1973	292	.60	377	14.1	16.6	19.1	21.7	24.2
	(1) 90.1	-19	-2	1927	292	.60	370	14.0	16.6	19.2	21.8	24.4
	88.3	-29	-12	1879	292	.60	363	14.0	16.6	19.3	22.0	24.6
	86.0	-9	5	1550	257	.53	333	15.1	18.3	21.5	24.7	28.0
	86.0	-19	-4	1625	267	.55	339	14.7	17.8	20.9	23.9	27.0
	86.0	-29	-14	1700	277	.57	345	14.4	17.4	20.3	23.2	26.2
	81.0	-9	2	1265	225	.47	293	15.3	19.3	23.2	27.2	31.1
	81.0	-19	-8	1316	234	.48	299	15.2	19.0	22.8	26.6	30.4
	81.0	-29	-17	1381	246	.51	307	15.0	18.6	22.2	25.9	29.5
	76.0	-9	-1	1066	195	.41	255	14.6	19.3	24.0	28.7	33.3
	76.0	-19	-10	1092	203	.42	261	14.7	19.3	23.9	28.5	33.0
	76.0	-29	-20	1122	212	.44	267	14.9	19.3	23.8	28.2	32.7
	71.0	-9	-3	922	167	.35	219	12.9	18.4	23.8	29.2	34.6
	(2) 71.0	-19	-12	934	175	.36	225	13.3	18.7	24.0	29.4	34.7
	71.0	-29	-22	950	183	.38	230	13.7	19.0	24.3	29.5	34.8
14000.	91.7	-9	9	1961	292	.60	377	14.1	16.7	19.2	21.8	24.3
	(1) 89.9	-19	-2	1915	292	.60	370	14.1	16.7	19.3	21.9	24.6
	88.1	-29	-12	1864	292	.60	363	14.1	16.8	19.5	22.1	24.8
	86.0	-9	5	1551	258	.53	334	15.1	18.3	21.6	24.8	28.0
	86.0	-19	-4	1626	268	.55	341	14.8	17.9	20.9	24.0	27.1
	86.0	-29	-14	1702	279	.57	347	14.5	17.4	20.4	23.3	26.2
	80.0	-9	2	1219	221	.46	288	15.4	19.5	23.6	27.7	31.8
	80.0	-19	-8	1264	230	.48	294	15.4	19.3	23.3	27.2	31.2
	80.0	-29	-17	1324	241	.50	302	15.2	19.0	22.8	26.5	30.3
	74.0	-9	-1	1003	188	.39	247	14.6	19.6	24.6	29.6	34.6
	74.0	-19	-11	1023	195	.41	250	14.7	19.6	24.5	29.4	34.3
	74.0	-29	-21	1048	203	.42	256	14.8	19.6	24.4	29.2	33.9
	69.0	-9	-3	872	162	.34	212	12.9	18.6	24.4	30.1	35.8
	(2) 69.0	-19	-13	883	169	.35	218	13.3	19.0	24.7	30.3	36.0
	69.0	-29	-23	898	177	.37	223	13.7	19.3	24.8	30.4	36.0
13000.	91.5	-9	9	1951	292	.60	377	14.2	16.8	19.3	21.9	24.5
	(1) 89.8	-19	-2	1904	292	.60	370	14.2	16.8	19.4	22.1	24.7
	88.0	-29	-12	1857	292	.60	363	14.1	16.8	19.5	22.2	24.9
	85.0	-9	5	1497	254	.52	330	15.4	18.7	22.1	25.4	28.7
	85.0	-19	-5	1561	263	.54	335	15.0	18.2	21.4	24.6	27.8
	85.0	-29	-14	1633	274	.56	340	14.7	17.8	20.9	23.9	27.0
	79.0	-9	1	1181	218	.45	284	15.6	19.8	24.1	28.3	32.5
	79.0	-19	-8	1213	225	.47	289	15.5	19.7	23.8	27.9	32.0
	79.0	-29	-18	1267	235	.49	295	15.4	19.3	23.3	27.2	31.2
	73.0	-9	-1	976	186	.39	244	14.8	19.9	25.0	30.2	35.3
	73.0	-19	-11	991	193	.40	248	14.9	20.0	25.0	30.1	35.1
	73.0	-29	-21	1013	200	.42	252	15.0	19.9	24.9	29.8	34.7
	67.0	-9	-3	825	157	.33	206	12.9	18.9	25.0	31.0	37.1
	(2) 67.0	-19	-13	835	164	.34	211	13.3	19.3	25.3	31.3	37.3
	67.0	-29	-23	848	171	.36	216	13.7	19.6	25.4	31.3	37.2
12000.	91.4	-9	9	1941	292	.60	377	14.3	16.9	19.4	22.0	24.6
	(1) 89.6	-19	-2	1894	292	.60	370	14.3	16.9	19.5	22.2	24.8
	87.9	-29	-12	1848	292	.60	363	14.2	16.9	19.6	22.3	25.0
	84.0	-9	4	1438	249	.51	324	15.6	19.0	22.5	26.0	29.5
	84.0	-19	-5	1497	258	.53	329	15.3	18.6	22.0	25.3	28.6
	84.0	-29	-15	1565	268	.55	334	14.9	18.1	21.3	24.5	27.7
	78.0	-9	1	1146	215	.45	281	15.8	20.2	24.5	28.9	33.2
	78.0	-19	-9	1175	222	.46	285	15.7	20.0	24.2	28.5	32.7
	78.0	-29	-18	1212	230	.48	289	15.6	19.7	23.8	28.0	32.1
	71.0	-9	-2	924	181	.38	238	14.9	20.3	25.7	31.1	36.6
	71.0	-19	-12	937	187	.39	240	14.9	20.3	25.6	31.0	36.3
	71.0	-29	-21	952	193	.40	244	15.1	20.3	25.6	30.8	36.1
	65.0	-9	-4	783	153	.32	201	12.8	19.2	25.6	32.0	38.4
	(2) 65.0	-19	-14	789	159	.33	204	13.2	19.6	25.9	32.2	38.6
	65.0	-29	-23	799	165	.35	209	13.6	19.8	26.1	32.4	38.6

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-9°C	-19°C	-29°C
89.4	89.9	88.1
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 4 of 18)

CRUISE
19,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL				
								100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	92.9	-13	6	1951	289	.62	385	14.6	17.2	19.7	22.3	24.9
	(1) 91.5	-23	-5	1942	292	.62	381	14.5	17.1	19.6	22.2	24.8
	89.7	-33	-15	1898	292	.62	374	14.4	17.1	19.7	22.3	25.0
	88.0	-13	2	1584	260	.56	347	15.6	18.8	21.9	25.1	28.2
	88.0	-23	-7	1657	269	.58	353	15.3	18.3	21.3	24.3	27.3
	88.0	-33	-17	1751	281	.60	360	14.8	17.7	20.6	23.4	26.3
	84.0	-13	0	1346	233	.50	314	15.9	19.6	23.3	27.0	30.7
	84.0	-23	-10	1404	244	.52	321	15.7	19.3	22.8	26.4	30.0
	84.0	-33	-19	1474	255	.55	329	15.5	18.9	22.3	25.7	29.1
	79.0	-13	-4	1095	199	.43	269	15.4	20.0	24.6	29.1	33.7
	79.0	-23	-13	1137	210	.45	277	15.6	20.0	24.4	28.8	33.2
	79.0	-33	-22	1194	222	.48	288	15.7	19.9	24.1	28.3	32.5
	75.0	-13	-6	966	174	.38	236	14.1	19.3	24.5	29.6	34.8
	(2) 75.0	-23	-15	987	184	.40	244	14.6	19.6	24.7	29.8	34.8
	75.0	-33	-25	1010	192	.42	250	14.9	19.8	24.8	29.7	34.7
15000.	92.9	-13	6	1952	290	.62	386	14.7	17.2	19.8	22.4	24.9
	(1) 91.3	-23	-5	1929	292	.62	381	14.6	17.2	19.8	22.4	25.0
	89.5	-33	-15	1885	292	.62	374	14.5	17.2	19.8	22.5	25.1
	88.0	-13	2	1585	260	.56	349	15.7	18.8	22.0	25.1	28.3
	88.0	-23	-7	1658	271	.58	354	15.3	18.4	21.4	24.4	27.4
	88.0	-33	-16	1753	282	.60	361	14.9	17.8	20.6	23.5	26.3
	83.0	-13	-1	1295	229	.49	308	16.1	20.0	23.8	27.7	31.5
	83.0	-23	-10	1347	239	.51	315	16.0	19.7	23.4	27.1	30.8
	83.0	-33	-20	1409	250	.54	322	15.7	19.3	22.8	26.4	29.9
	78.0	-13	-4	1064	197	.43	266	15.6	20.3	25.0	29.7	34.4
	78.0	-23	-13	1092	206	.44	272	15.8	20.4	24.9	29.5	34.1
	78.0	-33	-23	1142	217	.47	282	15.9	20.3	24.7	29.0	33.4
	73.0	-13	-6	908	168	.36	227	14.0	19.5	25.0	30.5	36.0
	(2) 73.0	-23	-16	927	176	.38	234	14.5	19.9	25.2	30.6	36.0
	73.0	-33	-25	947	185	.40	241	14.9	20.1	25.4	30.7	36.0
14000.	92.9	-13	6	1951	291	.62	387	14.7	17.3	19.8	22.4	25.0
	(1) 91.2	-23	-5	1917	292	.62	381	14.7	17.3	19.9	22.5	25.1
	89.4	-33	-15	1873	292	.62	374	14.6	17.3	20.0	22.6	25.3
	87.0	-13	2	1521	256	.55	343	16.0	19.3	22.6	25.9	29.1
	87.0	-23	-8	1593	266	.57	349	15.6	18.7	21.9	25.0	28.2
	87.0	-33	-17	1675	277	.59	355	15.2	18.2	21.2	24.2	27.2
	82.0	-13	-1	1244	225	.49	303	16.4	20.4	24.4	28.4	32.4
	82.0	-23	-11	1294	235	.50	310	16.2	20.1	23.9	27.8	31.6
	82.0	-33	-20	1353	245	.53	317	16.0	19.7	23.4	27.1	30.8
	76.0	-13	-4	998	190	.41	257	15.7	20.7	25.7	30.7	35.7
	76.0	-23	-14	1024	198	.43	262	15.8	20.7	25.6	30.5	35.4
	76.0	-33	-24	1053	207	.45	268	16.0	20.7	25.5	30.2	35.0
	71.0	-13	-7	860	162	.35	220	14.0	19.8	25.6	31.4	37.2
	(2) 71.0	-23	-16	872	170	.37	226	14.4	20.2	25.9	31.6	37.4
	71.0	-33	-26	890	178	.39	232	14.8	20.4	26.1	31.7	37.3
13000.	92.9	-13	6	1952	292	.62	389	14.8	17.4	19.9	22.5	25.0
	(1) 91.1	-23	-5	1907	292	.62	381	14.8	17.4	20.0	22.6	25.2
	89.2	-33	-15	1863	292	.62	374	14.7	17.4	20.1	22.7	25.4
	86.0	-13	1	1462	252	.54	337	16.2	19.6	23.1	26.5	29.9
	86.0	-23	-8	1532	261	.56	343	15.9	19.1	22.4	25.7	28.9
	86.0	-33	-18	1601	271	.58	348	15.5	18.6	21.7	24.8	28.0
	81.0	-13	-2	1194	221	.48	298	16.6	20.8	25.0	29.2	33.4
	81.0	-23	-11	1243	231	.50	304	16.4	20.5	24.5	28.5	32.5
	81.0	-33	-21	1305	242	.52	312	16.2	20.1	23.9	27.7	31.5
	75.0	-13	-5	968	188	.41	254	15.9	21.1	26.3	31.4	36.6
	75.0	-23	-14	992	196	.42	259	16.1	21.1	26.2	31.2	36.2
	75.0	-33	-24	1019	204	.44	265	16.2	21.1	26.0	30.9	35.8
	69.0	-13	-7	814	158	.34	214	14.0	20.1	26.3	32.4	38.6
	(2) 69.0	-23	-17	826	165	.36	219	14.5	20.5	26.6	32.6	38.7
	69.0	-33	-26	840	172	.37	224	14.8	20.8	26.7	32.7	38.6
12000.	92.7	-13	6	1941	292	.62	389	14.9	17.5	20.0	22.6	25.2
	(1) 90.9	-23	-5	1897	292	.62	381	14.8	17.5	20.1	22.7	25.4
	89.1	-33	-15	1853	292	.62	374	14.8	17.5	20.2	22.9	25.6
	86.0	-13	2	1463	253	.54	339	16.4	19.8	23.2	26.6	30.0
	86.0	-23	-8	1533	263	.56	344	15.9	19.2	22.5	25.7	29.0
	86.0	-33	-17	1603	273	.58	350	15.6	18.7	21.8	24.9	28.0
	79.0	-13	-2	1106	212	.46	286	16.8	21.4	25.9	30.4	34.9
	79.0	-23	-12	1143	220	.47	291	16.7	21.0	25.4	29.8	34.2
	79.0	-33	-22	1200	230	.50	298	16.5	20.7	24.8	29.0	33.2
	73.0	-13	-5	911	182	.39	246	16.1	21.5	27.0	32.5	38.0
	73.0	-23	-15	928	188	.41	250	16.1	21.5	26.9	32.3	37.7
	73.0	-33	-25	949	195	.42	254	16.2	21.5	26.7	32.0	37.3
	67.0	-13	-7	769	153	.33	207	13.9	20.4	26.9	33.4	40.0
	(2) 67.0	-23	-17	780	160	.35	213	14.5	20.9	27.3	33.7	40.1
	67.0	-33	-27	793	167	.36	218	14.8	21.1	27.4	33.7	40.1

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-13°C	-23°C	-33°C
89.9	91.3	89.5
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 5 of 18)

CRUISE
21,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL: 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	93.5	-17	2	1890	284	.63	390	15.4	18.0	20.7	23.3	25.9
	(1) 93.0	-27	-7	1955	292	.65	393	15.0	17.5	20.1	22.7	25.2
	91.1	-37	-18	1908	292	.65	385	14.9	17.6	20.2	22.8	25.4
	89.0	-17	-1	1550	256	.57	354	16.4	19.6	22.9	26.1	29.3
	89.0	-27	-10	1639	268	.59	362	16.0	19.0	22.1	25.1	28.2
	89.0	-37	-20	1737	279	.62	369	15.5	18.4	21.2	24.1	27.0
	85.0	-17	-4	1320	231	.52	321	16.8	20.6	24.3	28.1	31.9
	85.0	-27	-13	1377	242	.54	328	16.6	20.2	23.8	27.5	31.1
	85.0	-37	-23	1449	253	.56	336	16.3	19.8	23.2	26.7	30.1
	81.0	-17	-7	1115	204	.46	285	16.6	21.1	25.5	30.0	34.5
	81.0	-27	-16	1166	216	.48	295	16.7	21.0	25.3	29.6	33.9
	81.0	-37	-25	1223	228	.51	304	16.7	20.8	24.8	28.9	33.0
	77.0	-17	-9	958	175	.40	246	15.2	20.4	25.6	30.8	36.1
	(2) 77.0	-27	-19	980	185	.42	254	15.7	20.8	25.9	31.0	36.1
	77.0	-37	-28	1029	199	.45	267	16.2	21.0	25.9	30.7	35.6
15000.	93.5	-17	2	1887	285	.63	391	15.4	18.1	20.7	23.4	26.0
	(1) 92.8	-27	-7	1942	292	.65	393	15.1	17.7	20.2	22.8	25.4
	90.9	-37	-18	1894	292	.65	385	15.0	17.7	20.3	23.0	25.6
	88.0	-17	-2	1490	252	.56	349	16.7	20.1	23.4	26.8	30.1
	88.0	-27	-11	1568	263	.58	355	16.3	19.5	22.7	25.9	29.0
	88.0	-37	-20	1659	274	.61	362	15.8	18.8	21.8	24.8	27.9
	84.0	-17	-4	1268	228	.51	316	17.1	21.0	24.9	28.9	32.8
	84.0	-27	-14	1322	237	.53	323	16.8	20.6	24.4	28.2	32.0
	84.0	-37	-23	1392	249	.55	331	16.6	20.2	23.8	27.4	31.0
	79.0	-17	-8	1026	194	.44	271	16.6	21.5	26.4	31.3	36.1
	79.0	-27	-17	1077	205	.46	281	16.8	21.4	26.1	30.7	35.4
	79.0	-37	-26	1126	217	.49	290	16.9	21.3	25.7	30.2	34.6
	75.0	-17	-10	903	169	.38	237	15.2	20.7	26.3	31.8	37.3
	(2) 75.0	-27	-19	922	178	.40	245	15.7	21.1	26.5	31.9	37.4
	75.0	-37	-29	946	187	.42	251	16.0	21.3	26.6	31.9	37.2
14000.	93.5	-17	3	1889	286	.63	393	15.5	18.1	20.8	23.4	26.1
	(1) 92.6	-27	-7	1930	292	.65	393	15.2	17.8	20.4	23.0	25.6
	90.7	-37	-18	1882	292	.65	385	15.1	17.8	20.5	23.1	25.8
	88.0	-17	-1	1491	254	.57	351	16.8	20.2	23.5	26.9	30.2
	88.0	-27	-11	1569	264	.59	357	16.4	19.6	22.7	25.9	29.1
	88.0	-37	-20	1661	275	.61	364	15.9	18.9	21.9	24.9	27.9
	83.0	-17	-5	1220	224	.50	311	17.3	21.4	25.5	29.6	33.7
	83.0	-27	-14	1269	233	.52	317	17.1	21.1	25.0	28.9	32.9
	83.0	-37	-24	1332	244	.54	325	16.9	20.6	24.4	28.1	31.9
	78.0	-17	-8	995	192	.43	268	16.9	21.9	26.9	31.9	37.0
	78.0	-27	-17	1029	201	.45	275	17.0	21.9	26.7	31.6	36.5
	78.0	-37	-27	1080	213	.48	285	17.1	21.7	26.4	31.0	35.6
	73.0	-17	-10	849	163	.37	229	15.2	21.0	26.9	32.8	38.7
	(2) 73.0	-27	-20	867	172	.39	236	15.7	21.4	27.2	33.0	38.7
	73.0	-37	-29	888	180	.41	242	16.0	21.7	27.3	32.9	38.6
13000.	93.5	-17	3	1890	287	.64	394	15.6	18.2	20.8	23.5	26.1
	(1) 92.5	-27	-7	1918	292	.65	393	15.3	17.9	20.5	23.1	25.7
	90.6	-37	-18	1870	292	.65	385	15.2	17.9	20.6	23.3	25.9
	87.0	-17	-2	1435	250	.56	345	17.1	20.6	24.1	27.6	31.0
	87.0	-27	-11	1502	259	.58	351	16.7	20.0	23.4	26.7	30.0
	87.0	-37	-21	1587	270	.60	357	16.2	19.4	22.5	25.7	28.8
	82.0	-17	-5	1173	221	.49	307	17.7	21.9	26.2	30.5	34.7
	82.0	-27	-15	1219	229	.51	312	17.4	21.5	25.6	29.7	33.8
	82.0	-37	-24	1280	240	.54	319	17.1	21.0	24.9	28.8	32.8
	76.0	-17	-8	934	185	.42	259	17.0	22.4	27.7	33.1	38.4
	76.0	-27	-18	958	193	.43	264	17.1	22.3	27.5	32.8	38.0
	76.0	-37	-28	986	201	.45	270	17.2	22.3	27.4	32.4	37.5
	71.0	-17	-11	801	158	.36	221	15.1	21.4	27.6	33.9	40.1
	(2) 71.0	-27	-20	811	165	.37	227	15.6	21.8	28.0	34.1	40.3
	71.0	-37	-30	834	174	.39	234	16.1	22.1	28.1	34.1	40.0
12000.	93.4	-17	3	1888	288	.64	395	15.6	18.3	20.9	23.6	26.2
	(1) 92.3	-27	-7	1908	292	.65	393	15.4	18.0	20.6	23.2	25.8
	90.4	-37	-18	1859	292	.65	385	15.3	18.0	20.7	23.4	26.1
	87.0	-17	-2	1436	251	.56	347	17.2	20.7	24.2	27.7	31.1
	87.0	-27	-11	1503	260	.58	352	16.8	20.1	23.4	26.8	30.1
	87.0	-37	-21	1589	271	.60	359	16.3	19.4	22.6	25.7	28.9
	81.0	-17	-5	1124	216	.49	301	17.9	22.4	26.8	31.3	35.7
	81.0	-27	-15	1172	225	.50	307	17.7	21.9	26.2	30.5	34.7
	81.0	-37	-24	1228	235	.53	314	17.4	21.5	25.6	29.6	33.7
	75.0	-17	-8	905	183	.41	256	17.2	22.8	28.3	33.8	39.3
	75.0	-27	-18	929	191	.43	261	17.4	22.7	28.1	33.5	38.9
	75.0	-37	-28	955	199	.45	267	17.5	22.7	27.9	33.2	38.4
	69.0	-17	-11	759	154	.35	216	15.3	21.9	28.4	35.0	41.6
	(2) 69.0	-27	-21	770	161	.36	221	15.7	22.2	28.7	35.2	41.7
	69.0	-37	-30	784	168	.38	226	16.1	22.5	28.8	35.2	41.6

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-17°C	-27°C	-37°C
90.5	91.8	91.0
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 6 of 18)

CRUISE
23,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	94.1	-21	-1	1829	278	.64	395	16.1	18.9	21.6	24.3	27.1
	(1) 94.6	-31	-10	1978	292	.67	405	15.4	18.0	20.5	23.0	25.5
	92.6	-41	-21	1933	292	.67	397	15.4	17.9	20.5	23.1	25.7
	90.0	-21	-4	1530	254	.59	363	17.2	20.5	23.7	27.0	30.3
	90.0	-31	-14	1617	265	.61	370	16.7	19.8	22.9	26.0	29.0
	90.0	-41	-23	1723	277	.64	377	16.1	19.0	21.9	24.8	27.7
	86.0	-21	-7	1291	229	.53	329	17.8	21.6	25.5	29.4	33.3
	86.0	-31	-17	1352	240	.56	336	17.5	21.2	24.9	28.6	32.2
	86.0	-41	-26	1429	251	.58	344	17.1	20.6	24.1	27.6	31.1
	82.0	-21	-10	1091	202	.47	292	17.6	22.1	26.7	31.3	35.9
	82.0	-31	-19	1141	214	.50	302	17.7	22.0	26.4	30.8	35.2
	82.0	-41	-29	1202	226	.53	311	17.5	21.7	25.9	30.0	34.2
	79.0	-21	-12	963	179	.42	259	16.5	21.7	26.9	32.1	37.3
	(2) 79.0	-31	-21	1009	193	.45	273	17.1	22.0	27.0	32.0	36.9
	79.0	-41	-31	1056	205	.48	284	17.4	22.1	26.9	31.6	36.3
15000.	94.0	-21	-1	1827	279	.64	396	16.2	18.9	21.7	24.4	27.2
	(1) 94.4	-31	-10	1961	292	.67	405	15.6	18.1	20.7	23.2	25.8
	92.5	-41	-21	1918	292	.67	397	15.5	18.1	20.7	23.3	25.9
	89.0	-21	-5	1466	250	.58	357	17.5	20.9	24.4	27.8	31.2
	89.0	-31	-14	1551	261	.60	364	17.0	20.2	23.5	26.7	29.9
	89.0	-41	-24	1643	272	.63	371	16.5	19.5	22.6	25.6	28.7
	85.0	-21	-8	1241	226	.53	324	18.1	22.1	26.1	30.1	34.2
	85.0	-31	-17	1300	236	.55	331	17.8	21.6	25.5	29.3	33.1
	85.0	-41	-26	1366	247	.57	338	17.4	21.1	24.8	28.4	32.1
	81.0	-21	-10	1049	199	.47	287	17.8	22.6	27.4	32.1	36.9
	81.0	-31	-20	1098	210	.49	297	17.9	22.5	27.0	31.6	36.1
	81.0	-41	-29	1157	222	.52	306	17.8	22.1	26.5	30.8	35.1
	77.0	-21	-13	893	170	.40	246	16.3	21.9	27.5	33.1	38.7
	(2) 77.0	-31	-22	923	181	.43	257	17.0	22.4	27.8	33.2	38.6
	77.0	-41	-32	969	194	.46	269	17.4	22.6	27.8	32.9	38.1
14000.	94.0	-21	-1	1824	280	.65	397	16.3	19.0	21.8	24.5	27.3
	(1) 94.2	-31	-10	1949	292	.67	405	15.7	18.2	20.8	23.4	25.9
	92.3	-41	-21	1903	292	.67	397	15.6	18.2	20.8	23.5	26.1
	89.0	-21	-5	1468	252	.58	359	17.7	21.1	24.5	27.9	31.3
	89.0	-31	-14	1554	262	.61	366	17.1	20.3	23.6	26.8	30.0
	89.0	-41	-23	1645	273	.63	373	16.6	19.6	22.6	25.7	28.7
	84.0	-21	-8	1192	222	.52	319	18.4	22.6	26.8	31.0	35.1
	84.0	-31	-17	1249	232	.54	326	18.1	22.1	26.1	30.1	34.1
	84.0	-41	-27	1309	242	.56	333	17.8	21.6	25.4	29.2	33.1
	79.0	-21	-11	968	190	.45	274	18.0	23.2	28.3	33.5	38.6
	79.0	-31	-21	1014	201	.47	284	18.1	23.0	28.0	32.9	37.8
	79.0	-41	-30	1060	212	.49	292	18.1	22.9	27.6	32.3	37.0
	75.0	-21	-14	842	164	.39	238	16.4	22.3	28.3	34.2	40.1
	(2) 75.0	-31	-23	860	173	.41	246	16.9	22.7	28.5	34.4	40.2
	75.0	-41	-33	885	182	.43	253	17.3	23.0	28.6	34.3	39.9
13000.	94.0	-21	-1	1827	281	.65	399	16.4	19.1	21.8	24.6	27.3
	(1) 94.0	-31	-10	1938	292	.67	405	15.8	18.3	20.9	23.5	26.1
	92.1	-41	-21	1891	292	.67	397	15.7	18.3	21.0	23.6	26.3
	88.0	-21	-5	1405	247	.57	353	18.0	21.6	25.1	28.7	32.3
	88.0	-31	-15	1482	257	.60	359	17.5	20.9	24.2	27.6	31.0
	88.0	-41	-24	1574	268	.62	366	16.9	20.1	23.3	26.5	29.6
	83.0	-21	-8	1145	219	.51	314	18.7	23.1	27.4	31.8	36.2
	83.0	-31	-18	1195	228	.53	320	18.4	22.6	26.8	31.0	35.2
	83.0	-41	-27	1257	238	.55	327	18.1	22.0	26.0	30.0	34.0
	78.0	-21	-12	931	187	.44	270	18.3	23.6	29.0	34.4	39.7
	78.0	-31	-21	970	197	.46	278	18.4	23.5	28.7	33.8	39.0
	78.0	-41	-30	1018	208	.49	287	18.4	23.3	28.3	33.2	38.1
	73.0	-21	-14	793	159	.38	231	16.5	22.8	29.1	35.4	41.7
	(2) 73.0	-31	-24	810	167	.39	238	17.0	23.2	29.3	35.5	41.7
	73.0	-41	-33	829	176	.41	244	17.4	23.4	29.4	35.4	41.5
12000.	94.0	-21	-1	1828	282	.65	400	16.4	19.1	21.9	24.6	27.4
	(1) 93.9	-31	-10	1927	292	.67	405	15.8	18.4	21.0	23.6	26.2
	91.9	-41	-21	1880	292	.67	397	15.8	18.4	21.1	23.8	26.4
	88.0	-21	-5	1407	248	.58	355	18.1	21.7	25.2	28.8	32.4
	88.0	-31	-14	1484	258	.60	361	17.6	21.0	24.3	27.7	31.1
	88.0	-41	-24	1576	270	.62	368	17.0	20.2	23.3	26.5	29.7
	82.0	-21	-9	1101	215	.50	309	19.0	23.5	28.1	32.6	37.1
	82.0	-31	-18	1147	223	.52	314	18.7	23.1	27.4	31.8	36.1
	82.0	-41	-28	1209	234	.54	322	18.4	22.5	26.6	30.8	34.9
	76.0	-21	-12	873	180	.42	261	18.4	24.2	29.9	35.6	41.4
	76.0	-31	-22	896	188	.44	266	18.5	24.1	29.7	35.3	40.9
	76.0	-41	-31	932	198	.46	274	18.6	24.0	29.4	34.7	40.1
	71.0	-21	-14	746	154	.36	223	16.5	23.2	29.9	36.6	43.3
	(2) 71.0	-31	-24	761	162	.38	230	17.1	23.6	30.2	36.8	43.4
	71.0	-41	-34	779	170	.40	236	17.5	23.9	30.3	36.8	43.2

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-21°C	-31°C	-41°C
91.0	92.4	92.3
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 7 of 18)

CRUISE
25,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	94.6	-25	-5	1760	272	.65	399	17.0	19.8	22.7	25.5	28.3
	(1) 95.9	-35	-13	1978	290	.69	414	15.9	18.4	20.9	23.5	26.0
	94.3	-45	-24	1962	292	.70	409	15.8	18.3	20.9	23.4	25.9
	91.0	-25	-7	1508	252	.61	371	18.0	21.3	24.6	27.9	31.2
	91.0	-35	-17	1596	262	.63	377	17.4	20.5	23.6	26.8	29.9
	91.0	-45	-26	1701	274	.66	385	16.8	19.7	22.6	25.6	28.5
	87.0	-25	-10	1260	227	.55	336	18.8	22.7	26.7	30.7	34.6
	87.0	-35	-20	1326	237	.57	343	18.3	22.1	25.9	29.7	33.4
	87.0	-45	-29	1414	249	.60	353	17.9	21.4	25.0	28.5	32.0
	83.0	-25	-13	1069	200	.49	298	18.6	23.2	27.9	32.6	37.3
	83.0	-35	-23	1120	211	.51	308	18.6	23.0	27.5	32.0	36.4
	83.0	-45	-32	1174	223	.54	317	18.5	22.8	27.0	31.3	35.5
	80.0	-25	-16	941	177	.43	265	17.5	22.8	28.1	33.4	38.7
	(2) 80.0	-35	-25	986	190	.47	278	18.1	23.2	28.2	33.3	38.4
	80.0	-45	-34	1033	203	.49	290	18.4	23.2	28.1	32.9	37.7
15000.	94.6	-25	-5	1760	273	.66	401	17.1	19.9	22.8	25.6	28.4
	(1) 95.9	-35	-13	1982	291	.70	416	15.9	18.5	21.0	23.5	26.0
	94.1	-45	-24	1948	292	.70	409	15.9	18.4	21.0	23.6	26.1
	90.0	-25	-8	1446	248	.60	366	18.4	21.8	25.3	28.8	32.2
	90.0	-35	-17	1529	259	.62	373	17.9	21.1	24.4	27.7	30.9
	90.0	-45	-27	1626	269	.65	379	17.1	20.2	23.3	26.4	29.4
	86.0	-25	-11	1211	223	.54	331	19.0	23.2	27.3	31.4	35.6
	86.0	-35	-20	1275	233	.57	339	18.7	22.6	26.6	30.5	34.4
	86.0	-45	-30	1352	245	.59	347	18.3	22.0	25.7	29.4	33.1
	82.0	-25	-14	1027	198	.48	295	19.0	23.8	28.7	33.6	38.4
	82.0	-35	-23	1073	208	.51	303	18.9	23.6	28.2	32.9	37.6
	82.0	-45	-32	1131	220	.53	313	18.8	23.2	27.7	32.1	36.5
	79.0	-25	-16	906	175	.43	262	17.9	23.4	29.0	34.5	40.0
	(2) 79.0	-35	-25	949	188	.46	275	18.5	23.8	29.0	34.3	39.6
	79.0	-45	-34	990	200	.49	286	18.8	23.8	28.9	33.9	39.0
14000.	94.6	-25	-4	1766	275	.66	402	17.1	20.0	22.8	25.6	28.4
	(1) 95.9	-35	-13	1978	292	.70	417	16.0	18.5	21.1	23.6	26.1
	93.9	-45	-24	1935	292	.70	409	16.0	18.5	21.1	23.7	26.3
	90.0	-25	-8	1448	249	.60	368	18.5	22.0	25.4	28.9	32.3
	90.0	-35	-17	1530	259	.62	374	17.9	21.2	24.4	27.7	31.0
	90.0	-45	-27	1629	271	.65	381	17.2	20.3	23.4	26.5	29.5
	85.0	-25	-11	1165	219	.53	326	19.4	23.7	28.0	32.3	36.6
	85.0	-35	-21	1222	229	.56	333	19.1	23.2	27.3	31.3	35.4
	85.0	-45	-30	1293	241	.58	341	18.6	22.5	26.4	30.2	34.1
	81.0	-25	-14	988	195	.48	291	19.3	24.4	29.4	34.5	39.5
	81.0	-35	-23	1034	205	.50	299	19.3	24.1	28.9	33.8	38.6
	81.0	-45	-33	1087	216	.53	308	19.1	23.7	28.3	32.9	37.5
	77.0	-25	-17	832	165	.40	247	17.7	23.7	29.7	35.7	41.7
	(2) 77.0	-35	-26	869	177	.43	260	18.4	24.2	29.9	35.7	41.4
	77.0	-45	-35	912	190	.46	272	18.9	24.3	29.8	35.3	40.8
13000.	94.6	-25	-4	1764	275	.66	403	17.2	20.0	22.9	25.7	28.5
	(1) 95.7	-35	-13	1970	292	.70	418	16.1	18.7	21.2	23.7	26.3
	93.7	-45	-24	1924	292	.70	409	16.1	18.7	21.3	23.9	26.5
	89.0	-25	-8	1386	245	.59	362	18.9	22.5	26.1	29.7	33.3
	89.0	-35	-18	1469	256	.62	369	18.3	21.7	25.1	28.5	31.9
	89.0	-45	-27	1556	266	.64	374	17.6	20.8	24.1	27.3	30.5
	84.0	-25	-12	1120	216	.53	321	19.7	24.2	28.7	33.1	37.6
	84.0	-35	-21	1175	226	.55	328	19.4	23.7	27.9	32.2	36.4
	84.0	-45	-31	1235	236	.57	335	19.0	23.1	27.1	31.2	35.2
	79.0	-25	-15	912	186	.46	278	19.5	25.0	30.5	36.0	41.5
	79.0	-35	-24	953	196	.48	286	19.6	24.8	30.1	35.3	40.6
	79.0	-45	-34	996	206	.50	295	19.5	24.6	29.6	34.6	39.6
	75.0	-25	-17	784	160	.39	240	17.8	24.2	30.5	36.9	43.3
	(2) 75.0	-35	-27	801	168	.41	247	18.3	24.6	30.8	37.1	43.3
	75.0	-45	-36	834	179	.44	257	18.8	24.8	30.8	36.8	42.8
12000.	94.6	-25	-4	1767	276	.66	405	17.3	20.1	22.9	25.8	28.6
	(1) 95.6	-35	-13	1958	292	.70	418	16.2	18.8	21.3	23.9	26.4
	93.6	-45	-24	1913	292	.70	409	16.2	18.8	21.4	24.0	26.6
	89.0	-25	-8	1388	247	.60	364	19.0	22.6	26.2	29.8	33.4
	89.0	-35	-18	1471	257	.62	370	18.4	21.8	25.2	28.6	32.0
	89.0	-45	-27	1558	267	.64	376	17.7	20.9	24.2	27.4	30.6
	83.0	-25	-12	1075	213	.52	316	20.1	24.8	29.4	34.1	38.7
	83.0	-35	-22	1128	222	.54	323	19.8	24.2	28.6	33.1	37.5
	83.0	-45	-31	1182	232	.56	330	19.4	23.7	27.9	32.1	36.3
	78.0	-25	-15	872	182	.45	273	19.8	25.5	31.3	37.0	42.7
	78.0	-35	-25	915	193	.47	282	19.9	25.4	30.8	36.3	41.7
	78.0	-45	-34	956	203	.49	290	19.9	25.1	30.3	35.6	40.8
	73.0	-25	-18	739	155	.38	233	18.0	24.7	31.5	38.3	45.0
	(2) 73.0	-35	-27	756	163	.40	240	18.5	25.1	31.8	38.4	45.0
	73.0	-45	-37	776	172	.42	247	18.9	25.4	31.8	38.2	44.7

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-25°C	-35°C	-45°C
91.6	92.9	93.7
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 8 of 18)

CRUISE
27,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	95.2	-28	-8	1698	266	.67	403	17.8	20.8	23.7	26.7	29.6
	(1) 96.5	-38	-17	1907	283	.71	418	16.7	19.3	21.9	24.5	27.2
	96.6	-48	-26	2002	292	.73	422	16.1	18.6	21.1	23.6	26.1
	91.0	-28	-12	1415	242	.61	370	19.1	22.6	26.1	29.7	33.2
	91.0	-38	-21	1504	254	.64	378	18.5	21.8	25.1	28.5	31.8
	91.0	-48	-30	1599	264	.66	384	17.8	20.9	24.0	27.2	30.3
	88.0	-28	-14	1237	224	.57	343	19.7	23.7	27.8	31.8	35.8
	88.0	-38	-23	1305	234	.59	351	19.2	23.1	26.9	30.7	34.6
	88.0	-48	-32	1397	247	.62	361	18.7	22.2	25.8	29.4	33.0
	84.0	-28	-17	1042	197	.50	304	19.6	24.4	29.2	34.0	38.8
	84.0	-38	-26	1093	209	.53	314	19.6	24.2	28.8	33.3	37.9
	84.0	-48	-35	1156	221	.56	325	19.5	23.8	28.1	32.4	36.8
	81.0	-28	-20	917	173	.44	269	18.4	23.8	29.3	34.7	40.2
	(2) 81.0	-38	-28	964	188	.48	285	19.1	24.3	29.5	34.7	39.9
	81.0	-48	-38	1012	200	.51	296	19.4	24.3	29.3	34.2	39.1
15000.	95.2	-28	-8	1699	267	.67	405	17.9	20.9	23.8	26.8	29.7
	(1) 96.5	-38	-17	1912	284	.71	420	16.7	19.3	21.9	24.6	27.2
	96.3	-48	-26	1986	292	.73	422	16.2	18.7	21.2	23.7	26.3
	91.0	-28	-11	1418	244	.62	373	19.2	22.8	26.3	29.8	33.3
	91.0	-38	-21	1507	255	.64	380	18.6	21.9	25.2	28.6	31.9
	91.0	-48	-30	1601	266	.67	386	17.9	21.0	24.1	27.2	30.4
	87.0	-28	-14	1183	220	.56	338	20.1	24.3	28.6	32.8	37.0
	87.0	-38	-24	1250	231	.58	346	19.7	23.7	27.7	31.7	35.7
	87.0	-48	-33	1336	243	.61	355	19.1	22.8	26.6	30.3	34.1
	83.0	-28	-17	1002	195	.50	300	20.0	25.0	30.0	35.0	40.0
	83.0	-38	-27	1048	206	.52	310	20.0	24.8	29.6	34.4	39.1
	83.0	-48	-36	1105	217	.55	319	19.9	24.4	28.9	33.4	38.0
	80.0	-28	-20	885	173	.44	268	19.0	24.6	30.3	35.9	41.6
	(2) 80.0	-38	-29	928	186	.47	282	19.6	25.0	30.4	35.8	41.1
	80.0	-48	-38	972	198	.50	292	19.8	24.9	30.1	35.2	40.3
14000.	95.1	-28	-8	1699	268	.67	406	18.0	21.0	23.9	26.9	29.8
	(1) 96.5	-38	-16	1917	285	.71	421	16.8	19.4	22.0	24.6	27.2
	96.1	-48	-26	1977	292	.73	422	16.3	18.8	21.3	23.9	26.4
	91.0	-28	-11	1421	247	.62	376	19.4	22.9	26.5	30.0	33.5
	91.0	-38	-20	1509	257	.64	383	18.7	22.0	25.3	28.7	32.0
	91.0	-48	-30	1604	267	.67	388	18.0	21.1	24.2	27.3	30.4
	87.0	-28	-14	1186	223	.56	342	20.4	24.6	28.8	33.0	37.2
	87.0	-38	-23	1253	233	.59	349	19.8	23.8	27.8	31.8	35.8
	87.0	-48	-33	1339	245	.62	358	19.3	23.0	26.7	30.5	34.2
	83.0	-28	-17	1005	198	.50	306	20.5	25.5	30.5	35.4	40.4
	83.0	-38	-26	1051	209	.53	315	20.4	25.2	29.9	34.7	39.4
	83.0	-48	-36	1108	220	.56	323	20.1	24.7	29.2	33.7	38.2
	79.0	-28	-20	851	171	.44	266	19.5	25.3	31.2	37.1	43.0
	(2) 79.0	-38	-29	890	184	.47	278	20.0	25.6	31.3	36.9	42.5
	79.0	-48	-38	933	195	.50	288	20.2	25.5	30.9	36.3	41.6
13000.	95.1	-28	-8	1700	269	.67	408	18.1	21.1	24.0	26.9	29.9
	(1) 96.4	-38	-16	1913	286	.71	422	16.8	19.4	22.1	24.7	27.3
	95.8	-48	-26	1964	292	.73	422	16.4	18.9	21.5	24.0	26.6
	90.0	-28	-12	1361	242	.61	370	19.8	23.5	27.2	30.8	34.5
	90.0	-38	-21	1451	253	.64	378	19.1	22.6	26.0	29.5	32.9
	90.0	-48	-30	1537	263	.66	383	18.4	21.6	24.9	28.2	31.4
	86.0	-28	-14	1137	219	.56	337	20.8	25.2	29.6	34.0	38.4
	86.0	-38	-24	1200	229	.58	343	20.3	24.4	28.6	32.8	36.9
	86.0	-48	-33	1280	240	.61	352	19.7	23.6	27.5	31.4	35.3
	81.0	-28	-18	923	189	.48	292	20.8	26.3	31.7	37.1	42.5
	81.0	-38	-27	972	200	.51	303	20.8	26.0	31.1	36.3	41.4
	81.0	-48	-37	1017	210	.53	310	20.6	25.6	30.5	35.4	40.3
	77.0	-28	-21	780	162	.41	251	19.3	25.7	32.2	38.6	45.0
	(2) 77.0	-38	-30	818	174	.44	264	20.0	26.2	32.3	38.4	44.5
	77.0	-48	-39	857	186	.47	275	20.4	26.3	32.1	37.9	43.8
12000.	95.1	-28	-8	1701	270	.68	410	18.2	21.1	24.1	27.0	30.0
	(1) 96.5	-38	-16	1920	287	.72	424	16.9	19.5	22.1	24.7	27.3
	95.6	-48	-26	1953	292	.73	422	16.5	19.0	21.6	24.2	26.7
	89.0	-28	-12	1308	239	.60	365	20.2	24.0	27.9	31.7	35.5
	89.0	-38	-21	1384	249	.63	371	19.6	23.2	26.8	30.5	34.1
	89.0	-48	-31	1471	259	.65	377	18.8	22.2	25.6	29.0	32.4
	84.0	-28	-16	1049	210	.53	324	21.3	26.1	30.8	35.6	40.4
	84.0	-38	-25	1104	220	.56	331	20.9	25.4	30.0	34.5	39.0
	84.0	-48	-34	1166	230	.58	338	20.4	24.7	29.0	33.3	37.6
	79.0	-28	-19	856	182	.46	281	21.1	27.0	32.8	38.7	44.5
	79.0	-38	-28	894	191	.49	289	21.2	26.8	32.4	38.0	43.5
	79.0	-48	-38	937	201	.51	298	21.1	26.4	31.8	37.1	42.4
	74.0	-28	-22	707	150	.39	233	18.8	25.9	33.0	40.0	47.1
	(2) 74.0	-38	-31	722	158	.41	241	19.5	26.4	33.3	40.3	47.2
	74.0	-48	-41	752	169	.43	251	20.1	26.8	33.4	40.1	46.7

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-28°C	-38°C	-48°C
92.2	93.4	94.8
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 9 of 18)

CRUISE
29,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	95.8	-32	-12	1642	259	.68	407	18.7	21.7	24.8	27.8	30.9
	(1) 97.1	-42	-21	1821	275	.72	420	17.6	20.3	23.1	25.8	28.6
	98.4	-52	-30	1991	288	.75	429	16.5	19.1	21.6	24.1	26.6
	92.0	-32	-15	1390	239	.63	377	19.9	23.5	27.1	30.7	34.3
	92.0	-42	-24	1482	250	.66	386	19.3	22.6	26.0	29.4	32.8
	92.0	-52	-33	1581	261	.68	392	18.5	21.6	24.8	27.9	31.1
	89.0	-32	-17	1208	220	.58	350	20.7	24.8	29.0	33.1	37.2
	89.0	-42	-26	1288	232	.61	359	20.1	24.0	27.9	31.7	35.6
	89.0	-52	-36	1377	244	.64	368	19.5	23.1	26.7	30.4	34.0
	86.0	-32	-20	1057	200	.53	319	20.7	25.5	30.2	34.9	39.6
	86.0	-42	-29	1119	213	.56	331	20.6	25.1	29.6	34.0	38.5
	86.0	-52	-38	1191	225	.59	341	20.3	24.4	28.6	32.8	37.0
	83.0	-32	-22	930	178	.47	285	19.9	25.3	30.6	36.0	41.4
	(2) 83.0	-42	-31	975	191	.51	299	20.4	25.5	30.7	35.8	40.9
	83.0	-52	-40	1031	204	.54	312	20.5	25.4	30.2	35.1	39.9
15000.	95.7	-32	-12	1644	261	.68	409	18.8	21.8	24.9	27.9	31.0
	(1) 97.1	-42	-20	1821	276	.72	421	17.7	20.4	23.2	25.9	28.6
	98.4	-52	-29	1993	290	.75	431	16.6	19.1	21.6	24.1	26.6
	92.0	-32	-15	1393	241	.63	380	20.1	23.7	27.3	30.9	34.5
	92.0	-42	-24	1485	252	.66	388	19.4	22.8	26.1	29.5	32.9
	92.0	-52	-33	1584	262	.69	394	18.6	21.7	24.9	28.0	31.2
	88.0	-32	-18	1160	217	.57	345	21.1	25.4	29.8	34.1	38.4
	88.0	-42	-27	1232	228	.60	354	20.6	24.7	28.7	32.8	36.8
	88.0	-52	-36	1320	240	.63	363	19.9	23.7	27.5	31.3	35.1
	84.0	-32	-21	975	192	.51	306	21.2	26.3	31.4	36.5	41.7
	84.0	-42	-30	1024	202	.54	316	21.1	26.0	30.8	35.7	40.6
	84.0	-52	-39	1087	215	.57	327	20.9	25.5	30.1	34.7	39.3
	81.0	-32	-23	857	168	.45	270	19.9	25.7	31.5	37.4	43.2
	(2) 81.0	-42	-32	902	183	.49	286	20.6	26.2	31.7	37.3	42.8
	81.0	-52	-41	948	195	.52	298	20.9	26.1	31.4	36.7	42.0
14000.	95.7	-32	-12	1644	262	.68	411	18.9	21.9	25.0	28.0	31.1
	(1) 97.1	-42	-20	1826	277	.72	423	17.7	20.4	23.2	25.9	28.7
	98.4	-52	-29	1994	290	.75	432	16.7	19.2	21.7	24.2	26.7
	91.0	-32	-15	1336	237	.62	375	20.6	24.3	28.1	31.8	35.6
	91.0	-42	-24	1424	249	.65	383	19.9	23.4	26.9	30.4	33.9
	91.0	-52	-34	1515	258	.68	388	19.0	22.3	25.6	28.9	32.2
	87.0	-32	-18	1111	214	.57	340	21.6	26.1	30.6	35.1	39.6
	87.0	-42	-27	1179	224	.59	348	21.1	25.3	29.5	33.8	38.0
	87.0	-52	-37	1264	237	.62	358	20.4	24.4	28.3	32.3	36.2
	84.0	-32	-20	978	195	.52	312	21.7	26.8	31.9	37.0	42.1
	84.0	-42	-30	1027	206	.55	321	21.6	26.4	31.3	36.2	41.0
	84.0	-52	-39	1090	218	.57	331	21.2	25.8	30.4	34.9	39.5
	80.0	-32	-23	828	169	.45	271	20.6	26.6	32.7	38.7	44.7
	(2) 80.0	-42	-32	868	181	.48	284	21.2	26.9	32.7	38.5	44.2
	80.0	-52	-42	912	193	.51	295	21.3	26.8	32.3	37.8	43.3
13000.	95.7	-32	-11	1646	263	.69	413	19.0	22.0	25.1	28.1	31.2
	(1) 97.0	-42	-20	1823	278	.72	424	17.8	20.5	23.3	26.0	28.8
	98.4	-52	-29	1996	292	.75	434	16.7	19.2	21.7	24.2	26.8
	91.0	-32	-15	1338	239	.63	378	20.8	24.5	28.2	32.0	35.7
	91.0	-42	-24	1427	250	.66	385	20.0	23.5	27.0	30.5	34.0
	91.0	-52	-34	1518	260	.68	391	19.1	22.4	25.7	29.0	32.3
	86.0	-32	-19	1065	211	.56	335	22.1	26.8	31.5	36.2	40.9
	86.0	-42	-28	1130	221	.58	343	21.5	26.0	30.4	34.8	39.3
	86.0	-52	-37	1207	233	.61	352	20.9	25.1	29.2	33.3	37.5
	82.0	-32	-21	903	187	.50	299	22.1	27.6	33.2	38.7	44.2
	82.0	-42	-31	946	197	.52	308	22.0	27.3	32.6	37.8	43.1
	82.0	-52	-40	998	208	.55	318	21.8	26.8	31.8	36.8	41.8
	78.0	-32	-24	764	160	.43	257	20.6	27.1	33.7	40.2	46.8
	(2) 78.0	-42	-33	798	172	.46	270	21.3	27.6	33.9	40.1	46.4
	78.0	-52	-43	838	184	.49	282	21.7	27.6	33.6	39.6	45.5
12000.	95.6	-32	-11	1643	264	.69	414	19.1	22.1	25.2	28.2	31.3
	(1) 97.0	-42	-20	1824	279	.72	426	17.9	20.6	23.3	26.1	28.8
	98.1	-52	-29	1982	292	.75	434	16.8	19.4	21.9	24.4	26.9
	90.0	-32	-15	1281	236	.62	372	21.3	25.2	29.1	33.0	36.9
	90.0	-42	-25	1365	246	.65	380	20.5	24.2	27.8	31.5	35.2
	90.0	-52	-34	1448	256	.67	385	19.7	23.1	26.6	30.0	33.5
	85.0	-32	-19	1026	208	.55	331	22.6	27.4	32.3	37.2	42.1
	85.0	-42	-28	1081	218	.57	338	22.0	26.7	31.3	35.9	40.5
	85.0	-52	-38	1152	229	.60	347	21.4	25.8	30.1	34.4	38.8
	81.0	-32	-22	866	185	.49	296	22.6	28.4	34.2	39.9	45.7
	81.0	-42	-31	912	195	.52	305	22.5	28.0	33.5	39.0	44.4
	81.0	-52	-40	958	205	.54	313	22.2	27.5	32.7	37.9	43.1
	76.0	-32	-25	701	151	.41	243	20.4	27.5	34.7	41.8	48.9
	(2) 76.0	-42	-34	732	163	.44	256	21.4	28.2	35.0	41.8	48.7
	76.0	-52	-43	770	175	.47	269	21.9	28.4	34.9	41.4	47.9

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-32°C	-42°C	-52°C
92.7	93.9	95.3
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 10 of 18)

CRUISE
31,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL: 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	96.3	-36	-16	1576	252	.69	409	19.6	22.8	26.0	29.2	32.3
	(1) 97.7	-46	-24	1729	266	.72	421	18.6	21.5	24.4	27.3	30.1
	98.8	-56	-33	1882	279	.75	430	17.5	20.2	22.8	25.5	28.2
	93.0	-36	-18	1363	235	.64	384	20.8	24.5	28.1	31.8	35.5
	93.0	-46	-27	1456	246	.67	392	20.0	23.5	26.9	30.3	33.8
	93.0	-56	-37	1547	256	.70	397	19.2	22.5	25.7	28.9	32.2
	90.0	-36	-21	1187	217	.60	356	21.6	25.8	30.0	34.2	38.5
	90.0	-46	-30	1267	228	.63	366	21.0	24.9	28.9	32.8	36.8
	90.0	-56	-39	1355	240	.66	375	20.3	24.0	27.7	31.4	35.0
	87.0	-36	-24	1025	195	.54	323	21.7	26.6	31.5	36.4	41.2
	87.0	-46	-32	1097	209	.58	337	21.6	26.2	30.8	35.3	39.9
	87.0	-56	-41	1178	222	.61	349	21.1	25.4	29.6	33.9	38.1
	84.0	-36	-26	900	172	.48	286	20.7	26.3	31.8	37.4	42.9
	(2) 84.0	-46	-35	952	188	.52	304	21.4	26.6	31.9	37.1	42.4
	84.0	-56	-44	1009	201	.56	318	21.6	26.5	31.5	36.4	41.4
15000.	96.3	-36	-15	1577	254	.69	412	19.8	22.9	26.1	29.3	32.5
	(1) 97.7	-46	-24	1735	268	.73	424	18.7	21.5	24.4	27.3	30.2
	98.5	-56	-33	1862	279	.75	430	17.7	20.4	23.1	25.8	28.5
	93.0	-36	-18	1367	238	.65	388	21.0	24.7	28.4	32.0	35.7
	93.0	-46	-27	1460	248	.68	395	20.2	23.6	27.0	30.5	33.9
	93.0	-56	-37	1551	258	.70	400	19.3	22.6	25.8	29.0	32.2
	89.0	-36	-21	1139	214	.59	352	22.2	26.6	30.9	35.3	39.7
	89.0	-46	-30	1212	225	.62	361	21.5	25.7	29.8	33.9	38.0
	89.0	-56	-39	1298	237	.65	370	20.8	24.7	28.5	32.4	36.2
	86.0	-36	-24	990	194	.54	321	22.3	27.4	32.4	37.5	42.5
	86.0	-46	-33	1052	207	.57	333	22.2	26.9	31.7	36.4	41.2
	86.0	-56	-42	1125	219	.60	344	21.7	26.1	30.6	35.0	39.4
	83.0	-36	-26	868	172	.48	286	21.5	27.2	33.0	38.7	44.5
	(2) 83.0	-46	-35	913	185	.52	301	22.0	27.4	32.9	38.4	43.9
	83.0	-56	-44	968	198	.55	313	22.0	27.2	32.4	37.5	42.7
14000.	96.3	-36	-15	1581	255	.70	414	19.9	23.0	26.2	29.4	32.5
	(1) 97.6	-46	-24	1734	269	.73	425	18.7	21.6	24.5	27.4	30.3
	98.1	-56	-33	1848	279	.75	430	17.9	20.6	23.3	26.0	28.7
	92.0	-36	-18	1309	234	.64	382	21.6	25.4	29.2	33.0	36.8
	92.0	-46	-28	1393	244	.67	389	20.8	24.4	27.9	31.5	35.1
	92.0	-56	-37	1494	255	.69	396	19.8	23.1	26.5	29.8	33.2
	88.0	-36	-21	1087	211	.58	347	22.7	27.3	31.9	36.5	41.1
	88.0	-46	-31	1162	222	.61	356	22.1	26.4	30.7	35.0	39.3
	88.0	-56	-40	1241	233	.64	365	21.4	25.4	29.4	33.4	37.5
	84.0	-36	-25	911	186	.52	308	22.8	28.3	33.8	39.3	44.8
	84.0	-46	-34	963	197	.55	319	22.8	28.0	33.1	38.3	43.5
	84.0	-56	-43	1021	209	.58	329	22.4	27.3	32.2	37.1	42.0
	81.0	-36	-27	801	164	.46	273	21.6	27.8	34.0	40.3	46.5
	(2) 81.0	-46	-36	843	178	.49	288	22.3	28.3	34.2	40.1	46.0
	81.0	-56	-45	890	190	.53	300	22.5	28.1	33.8	39.4	45.0
13000.	96.2	-36	-15	1581	257	.70	416	20.0	23.2	26.3	29.5	32.6
	(1) 97.6	-46	-24	1738	270	.73	427	18.8	21.7	24.6	27.4	30.3
	97.8	-56	-33	1831	279	.75	430	18.0	20.8	23.5	26.2	28.9
	92.0	-36	-18	1312	236	.65	386	21.8	25.6	29.4	33.2	37.0
	92.0	-46	-27	1396	246	.67	392	20.9	24.5	28.1	31.6	35.2
	92.0	-56	-37	1497	256	.70	398	19.9	23.2	26.6	29.9	33.2
	87.0	-36	-22	1042	208	.57	342	23.3	28.1	32.9	37.7	42.5
	87.0	-46	-31	1111	219	.60	351	22.6	27.1	31.6	36.1	40.6
	87.0	-56	-40	1188	230	.63	360	21.9	26.1	30.3	34.5	38.7
	83.0	-36	-25	877	184	.51	305	23.3	29.0	34.7	40.4	46.1
	83.0	-46	-34	922	195	.54	315	23.3	28.7	34.2	39.6	45.0
	83.0	-56	-43	978	206	.57	325	23.0	28.1	33.2	38.3	43.4
	79.0	-36	-28	741	157	.44	261	21.7	28.5	35.2	42.0	48.7
	(2) 79.0	-46	-37	777	170	.47	276	22.6	29.0	35.5	41.9	48.3
	79.0	-56	-46	818	181	.50	288	22.9	29.1	35.2	41.3	47.4
12000.	96.2	-36	-15	1583	258	.70	418	20.1	23.3	26.4	29.6	32.7
	(1) 97.6	-46	-24	1740	271	.74	428	18.9	21.8	24.6	27.5	30.4
	97.5	-56	-33	1816	279	.75	430	18.2	20.9	23.7	26.4	29.2
	91.0	-36	-18	1258	232	.64	380	22.3	26.2	30.2	34.2	38.2
	91.0	-46	-28	1340	243	.66	387	21.4	25.2	28.9	32.6	36.4
	91.0	-56	-37	1434	253	.69	393	20.4	23.9	27.4	30.9	34.4
	87.0	-36	-22	1046	211	.58	346	23.6	28.3	33.1	37.9	42.7
	87.0	-46	-31	1114	221	.61	355	22.9	27.4	31.9	36.3	40.8
	87.0	-56	-40	1191	232	.64	363	22.1	26.3	30.5	34.7	38.9
	82.0	-36	-25	845	182	.51	302	24.0	29.9	35.8	41.7	47.6
	82.0	-46	-34	885	192	.53	311	23.8	29.5	35.1	40.8	46.4
	82.0	-56	-44	936	203	.56	320	23.5	28.9	34.2	39.6	44.9
	78.0	-36	-28	714	157	.44	261	22.6	29.6	36.6	43.6	50.6
	(2) 78.0	-46	-37	747	169	.47	274	23.3	30.0	36.7	43.4	50.1
	78.0	-56	-46	786	180	.50	285	23.5	29.9	36.3	42.6	49.0

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-36°C	-46°C	-56°C
93.2	94.5	95.9
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 11 of 18)

CRUISE
33,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	96.9	-40	-19	1496	244	.70	410	20.7	24.1	27.4	30.8	34.1
	(1) 98.3	-50	-28	1643	257	.73	422	19.6	22.7	25.7	28.7	31.8
	98.5	-60	-38	1736	267	.75	426	18.8	21.7	24.5	27.4	30.3
	94.0	-40	-22	1336	230	.66	390	21.7	25.4	29.2	32.9	36.7
	94.0	-50	-31	1420	241	.69	397	20.9	24.4	28.0	31.5	35.0
	94.0	-60	-40	1492	249	.71	401	20.2	23.5	26.9	30.2	33.6
	91.0	-40	-24	1162	213	.61	362	22.6	26.9	31.2	35.5	39.8
	91.0	-50	-33	1245	224	.64	372	21.9	25.9	29.9	33.9	37.9
	91.0	-60	-42	1337	236	.68	382	21.1	24.8	28.6	32.3	36.0
	88.0	-40	-27	1000	191	.55	328	22.8	27.8	32.8	37.8	42.8
	88.0	-50	-36	1077	206	.59	344	22.6	27.2	31.9	36.5	41.2
	88.0	-60	-45	1159	219	.63	356	22.1	26.4	30.7	35.0	39.3
	86.0	-40	-29	911	175	.51	301	22.1	27.6	33.1	38.6	44.1
	(2) 86.0	-50	-38	972	191	.55	320	22.6	27.8	32.9	38.0	43.2
	86.0	-60	-46	1048	206	.59	336	22.5	27.3	32.0	36.8	41.6
15000.	96.9	-40	-19	1501	246	.70	414	20.9	24.2	27.6	30.9	34.2
	(1) 98.3	-50	-28	1648	259	.74	425	19.7	22.7	25.8	28.8	31.8
	98.1	-60	-38	1718	267	.75	426	19.0	21.9	24.8	27.7	30.6
	93.0	-40	-22	1285	228	.65	386	22.3	26.2	30.1	34.0	37.8
	93.0	-50	-31	1370	238	.68	394	21.4	25.1	28.7	32.4	36.0
	93.0	-60	-41	1445	247	.71	398	20.6	24.1	27.5	31.0	34.4
	90.0	-40	-24	1119	211	.61	359	23.1	27.6	32.1	36.5	41.0
	90.0	-50	-34	1188	221	.64	367	22.5	26.7	30.9	35.1	39.3
	90.0	-60	-43	1279	233	.67	377	21.7	25.6	29.5	33.4	37.3
	87.0	-40	-27	962	190	.55	326	23.4	28.6	33.8	39.0	44.2
	87.0	-50	-36	1033	204	.59	340	23.2	28.1	32.9	37.7	42.6
	87.0	-60	-45	1107	216	.62	351	22.6	27.2	31.7	36.2	40.7
	84.0	-40	-30	838	167	.49	287	22.3	28.3	34.2	40.2	46.2
	(2) 84.0	-50	-39	891	182	.53	305	23.1	28.7	34.3	39.9	45.5
	84.0	-60	-48	950	196	.57	320	23.2	28.5	33.7	39.0	44.3
14000.	96.8	-40	-19	1502	247	.70	416	21.0	24.4	27.7	31.0	34.4
	(1) 98.2	-50	-28	1646.	260	.74	426	19.8	22.9	25.9	28.9	32.0
	97.7	-60	-38	1698	267	.75	426	19.2	22.1	25.1	28.0	31.0
	93.0	-40	-22	1290	230	.66	390	22.5	26.4	30.2	34.1	38.0
	93.0	-50	-31	1372	240	.69	396	21.5	25.2	28.8	32.5	36.1
	93.0	-60	-40	1450	249	.71	401	20.7	24.2	27.6	31.1	34.5
	90.0	-40	-24	1124	214	.62	364	23.5	27.9	32.4	36.8	41.3
	90.0	-50	-33	1192	224	.64	372	22.8	27.0	31.2	35.4	39.6
	90.0	-60	-42	1281	235	.67	380	21.9	25.8	29.7	33.6	37.5
	86.0	-40	-27	925	188	.55	323	24.1	29.5	34.9	40.3	45.7
	86.0	-50	-36	989	201	.58	336	23.8	28.9	34.0	39.0	44.1
	86.0	-60	-46	1060	213	.61	346	23.2	27.9	32.7	37.4	42.1
	83.0	-40	-30	807	167	.49	287	23.2	29.4	35.6	41.8	48.0
	(2) 83.0	-50	-39	854	180	.52	303	23.7	29.6	35.5	41.3	47.2
	83.0	-60	-48	911	194	.56	317	23.8	29.3	34.8	40.3	45.8
13000.	96.8	-40	-19	1507	249	.71	419	21.1	24.5	27.8	31.1	34.4
	(1) 98.2	-50	-28	1649	262	.74	428	19.9	22.9	26.0	29.0	32.0
	97.3	-60	-38	1681	267	.75	426	19.4	22.4	25.3	28.3	31.3
	92.0	-40	-22	1230	227	.65	385	23.2	27.2	31.3	35.3	39.4
	92.0	-50	-31	1315	237	.68	391	22.1	25.9	29.7	33.5	37.3
	92.0	-60	-41	1401	247	.70	397	21.2	24.7	28.3	31.9	35.4
	89.0	-40	-24	1073	211	.61	359	24.1	28.8	33.4	38.1	42.7
	89.0	-50	-34	1142	221	.64	367	23.4	27.8	32.1	36.5	40.9
	89.0	-60	-43	1232	233	.67	376	22.4	26.5	30.5	34.6	38.6
	85.0	-40	-28	889	186	.54	320	24.7	30.3	35.9	41.6	47.2
	85.0	-50	-37	947	198	.57	332	24.5	29.8	35.0	40.3	45.6
	85.0	-60	-46	1014	210	.61	342	23.9	28.8	33.8	38.7	43.6
	81.0	-40	-31	747	160	.47	276	23.5	30.2	36.9	43.6	50.3
	(2) 81.0	-50	-40	787	173	.50	291	24.2	30.6	36.9	43.3	49.6
	81.0	-60	-49	832	185	.54	303	24.4	30.4	36.4	42.4	48.4
12000.	96.8	-40	-18	1506	250	.71	420	21.3	24.6	27.9	31.2	34.6
	(1) 98.1	-50	-27	1651	263	.75	430	20.0	23.0	26.1	29.1	32.1
	96.9	-60	-38	1666	267	.75	426	19.6	22.6	25.6	28.6	31.6
	92.0	-40	-22	1233	229	.66	388	23.3	27.4	31.5	35.5	39.6
	92.0	-50	-31	1318	239	.68	394	22.3	26.1	29.9	33.7	37.5
	92.0	-60	-41	1405	248	.71	399	21.3	24.9	28.4	32.0	35.5
	87.0	-40	-26	979	202	.58	345	25.1	30.2	35.3	40.4	45.5
	87.0	-50	-35	1045	213	.61	354	24.3	29.1	33.9	38.6	43.4
	87.0	-60	-44	1118	224	.64	362	23.5	28.0	32.4	36.9	41.4
	83.0	-40	-29	816	178	.52	306	25.3	31.4	37.6	43.7	49.8
	83.0	-50	-38	863	190	.55	318	25.2	31.0	36.8	42.6	48.4
	83.0	-60	-47	920	201	.58	328	24.8	30.2	35.6	41.1	46.5
	79.0	-40	-32	692	153	.45	265	23.8	31.1	38.3	45.5	52.7
	(2) 79.0	-50	-41	726	166	.48	279	24.7	31.5	38.4	45.3	52.2
	79.0	-60	-50	765	177	.51	291	24.9	31.5	38.0	44.5	51.1

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-40°C	-50°C	-60°C
93.7	95.1	96.4
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 12 of 18)

CRUISE
35,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	97.6	-44	-23	1421	235	.70	411	21.9	25.4	28.9	32.5	36.0
	(1) 98.9	-54	-32	1555	248	.74	422	20.7	23.9	27.1	30.4	33.6
	98.4	-64	-42	1607	255	.75	422	20.0	23.2	26.3	29.4	32.5
	95.0	-44	-25	1300	225	.67	395	22.7	26.5	30.4	34.2	38.1
	95.0	-54	-35	1367	234	.70	400	21.9	25.6	29.3	32.9	36.6
	95.0	-64	-44	1435	243	.72	404	21.2	24.7	28.1	31.6	35.1
	92.0	-44	-28	1137	208	.63	367	23.5	27.9	32.3	36.7	41.1
	92.0	-54	-37	1222	220	.66	379	22.8	26.9	31.0	35.1	39.2
	92.0	-64	-46	1288	230	.69	385	22.1	26.0	29.9	33.8	37.6
	90.0	-44	-30	1032	195	.59	346	23.8	28.7	33.5	38.4	43.2
	90.0	-54	-38	1112	208	.63	360	23.3	27.8	32.3	36.8	41.3
	90.0	-64	-47	1193	220	.66	370	22.6	26.8	31.0	35.2	39.4
	88.0	-44	-32	926	178	.54	317	23.5	28.9	34.3	39.7	45.1
	(2) 88.0	-54	-40	1001	195	.59	337	23.7	28.7	33.7	38.7	43.7
	88.0	-64	-49	1087	209	.63	352	23.2	27.8	32.4	37.0	41.6
15000.	97.5	-44	-23	1424	237	.71	415	22.1	25.6	29.1	32.6	36.1
	(1) 98.8	-54	-32	1559	250	.74	425	20.9	24.1	27.3	30.5	33.7
	97.8	-64	-42	1583	255	.75	422	20.4	23.5	26.7	29.8	33.0
	94.0	-44	-25	1256	223	.67	392	23.2	27.2	31.2	35.2	39.2
	94.0	-54	-35	1324	232	.69	397	22.4	26.2	30.0	33.8	37.5
	94.0	-64	-44	1392	241	.72	402	21.7	25.2	28.8	32.4	36.0
	91.0	-44	-28	1093	207	.62	365	24.2	28.8	33.4	37.9	42.5
	91.0	-54	-37	1171	218	.65	375	23.4	27.7	32.0	36.3	40.5
	91.0	-64	-46	1247	228	.68	382	22.6	26.6	30.6	34.7	38.7
	88.0	-44	-31	937	186	.56	330	24.5	29.9	35.2	40.6	45.9
	88.0	-54	-40	1010	200	.60	345	24.3	29.2	34.2	39.1	44.1
	88.0	-64	-48	1093	213	.64	358	23.6	28.2	32.7	37.3	41.9
	86.0	-44	-33	849	170	.52	303	23.9	29.8	35.7	41.5	47.4
	(2) 86.0	-54	-41	912	186	.56	323	24.4	29.9	35.4	40.9	46.3
	86.0	-64	-50	989	200	.60	339	24.1	29.2	34.2	39.3	44.3
14000.	97.4	-44	-23	1424	239	.71	417	22.3	25.8	29.3	32.8	36.3
	(1) 98.8	-54	-32	1561	252	.75	427	21.0	24.2	27.4	30.6	33.8
	97.3	-64	-42	1561	255	.75	422	20.6	23.8	27.0	30.3	33.5
	94.0	-44	-25	1260	226	.68	396	23.5	27.4	31.4	35.4	39.3
	94.0	-54	-34	1329	234	.70	401	22.6	26.4	30.1	33.9	37.7
	94.0	-64	-44	1397	243	.72	405	21.8	25.4	29.0	32.5	36.1
	90.0	-44	-28	1048	204	.61	360	24.8	29.6	34.4	39.2	43.9
	90.0	-54	-37	1121	215	.65	370	24.1	28.6	33.0	37.5	42.0
	90.0	-64	-47	1205	226	.68	379	23.2	27.3	31.5	35.6	39.8
	87.0	-44	-31	901	185	.56	328	25.3	30.9	36.4	42.0	47.5
	87.0	-54	-40	968	197	.60	342	25.0	30.1	35.3	40.5	45.6
	87.0	-64	-49	1043	210	.63	354	24.4	29.2	33.9	38.7	43.5
	84.0	-44	-34	781	162	.49	289	24.2	30.6	37.0	43.4	49.8
	(2) 84.0	-54	-43	830	176	.54	307	25.0	31.0	37.0	43.0	49.1
	84.0	-64	-51	894	191	.58	323	25.0	30.6	36.2	41.8	47.4
13000.	97.4	-44	-22	1427	241	.72	420	22.4	25.9	29.4	32.9	36.4
	(1) 98.8	-54	-31	1563	253	.75	430	21.1	24.3	27.5	30.7	33.9
	96.9	-64	-42	1542	255	.75	422	20.9	24.1	27.4	30.6	33.9
	93.0	-44	-25	1208	223	.67	391	24.1	28.3	32.4	36.5	40.7
	93.0	-54	-35	1286	232	.69	398	23.1	27.0	30.9	34.8	38.7
	93.0	-64	-44	1354	241	.72	402	22.3	26.0	29.7	33.4	37.1
	90.0	-44	-28	1052	207	.62	366	25.2	30.0	34.8	39.5	44.3
	90.0	-54	-37	1124	218	.65	375	24.4	28.9	33.3	37.8	42.2
	90.0	-64	-46	1209	229	.68	382	23.4	27.5	31.6	35.8	39.9
	86.0	-44	-31	866	184	.56	326	26.1	31.9	37.7	43.4	49.2
	86.0	-54	-40	927	195	.59	338	25.7	31.1	36.5	41.9	47.3
	86.0	-64	-49	1000	207	.62	350	25.0	30.0	35.0	40.0	45.0
	83.0	-44	-34	752	162	.49	290	25.3	31.9	38.6	45.2	51.9
	(2) 83.0	-54	-43	800	176	.53	306	25.8	32.0	38.3	44.5	50.8
	83.0	-64	-52	856	189	.57	320	25.8	31.6	37.4	43.3	49.1
12000.	97.4	-44	-22	1430	242	.72	423	22.6	26.1	29.5	33.0	36.5
	(1) 98.7	-54	-31	1564	255	.75	432	21.2	24.4	27.6	30.8	34.0
	96.4	-64	-42	1525	255	.75	422	21.1	24.4	27.7	31.0	34.2
	93.0	-44	-25	1208	225	.67	395	24.4	28.5	32.7	36.8	41.0
	93.0	-54	-34	1289	234	.70	400	23.3	27.2	31.0	34.9	38.8
	93.0	-64	-44	1357	243	.72	404	22.4	26.1	29.8	33.4	37.1
	89.0	-44	-28	1006	204	.62	361	25.9	30.9	35.9	40.8	45.8
	89.0	-54	-37	1075	215	.65	370	25.1	29.8	34.4	39.1	43.7
	89.0	-64	-47	1160	226	.68	378	24.0	28.3	32.6	36.9	41.2
	85.0	-44	-31	832	182	.55	324	26.9	32.9	38.9	44.9	50.9
	85.0	-54	-40	889	193	.58	335	26.4	32.1	37.7	43.3	48.9
	85.0	-64	-50	953	205	.62	345	25.7	31.0	36.2	41.4	46.7
	81.0	-44	-35	695	156	.48	279	25.8	33.0	40.2	47.4	54.6
	(2) 81.0	-54	-44	734	168	.51	294	26.4	33.2	40.1	46.9	53.7
	81.0	-64	-53	781	181	.55	307	26.5	32.9	39.3	45.7	52.1

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-44°C	-54°C	-64°C
94.3	95.7	96.5
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 13 of 18)

CRUISE
37,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	97.9	-47	-26	1316	224	.70	408	23.4	27.2	31.0	34.8	38.6
	(1) 99.0	-57	-35	1434	236	.74	418	22.2	25.7	29.2	32.7	36.2
	98.8	-67	-45	1495	243	.75	420	21.4	24.8	28.1	31.4	34.8
	96.0	-47	-27	1234	216	.68	395	23.9	28.0	32.0	36.1	40.1
	96.0	-57	-37	1297	225	.70	401	23.2	27.0	30.9	34.7	38.6
	96.0	-67	-46	1363	233	.73	405	22.4	26.0	29.7	33.4	37.0
	94.0	-47	-29	1144	206	.65	379	24.4	28.7	33.1	37.5	41.9
	94.0	-57	-38	1208	217	.68	387	23.8	27.9	32.0	36.2	40.3
	94.0	-67	-47	1272	226	.71	393	23.0	26.9	30.9	34.8	38.7
	92.0	-47	-31	1046	195	.61	359	24.7	29.5	34.3	39.1	43.8
	92.0	-57	-39	1118	207	.65	371	24.2	28.7	33.2	37.6	42.1
	92.0	-67	-49	1180	217	.68	379	23.6	27.9	32.1	36.3	40.6
	90.0	-47	-33	934	178	.57	330	24.6	30.0	35.3	40.7	46.0
	(2) 90.0	-57	-41	1022	195	.62	351	24.6	29.5	34.3	39.2	44.1
	90.0	-67	-50	1095	208	.65	364	24.1	28.7	33.2	37.8	42.4
15000.	97.9	-47	-25	1322	226	.71	412	23.6	27.4	31.2	35.0	38.7
	(1) 99.0	-57	-34	1437	238	.74	422	22.4	25.9	29.3	32.8	36.3
	98.2	-67	-45	1471	243	.75	420	21.7	25.1	28.5	31.9	35.3
	95.0	-47	-27	1197	215	.68	394	24.5	28.7	32.9	37.1	41.3
	95.0	-57	-37	1260	224	.70	399	23.7	27.7	31.7	35.7	39.6
	95.0	-67	-46	1324	232	.73	403	22.9	26.7	30.4	34.2	38.0
	93.0	-47	-29	1104	205	.65	377	25.1	29.6	34.1	38.7	43.2
	93.0	-57	-38	1170	215	.68	385	24.4	28.6	32.9	37.2	41.5
	93.0	-67	-48	1231	224	.70	391	23.6	27.7	31.7	35.8	39.9
	90.0	-47	-32	948	186	.59	343	25.7	30.9	36.2	41.5	46.7
	90.0	-57	-40	1028	200	.63	359	25.2	30.1	34.9	39.8	44.7
	90.0	-67	-50	1098	211	.66	369	24.5	29.1	33.6	38.2	42.7
	88.0	-47	-34	851	169	.54	314	25.2	31.0	36.9	42.8	48.7
	(2) 88.0	-57	-42	925	186	.59	336	25.6	31.0	36.4	41.8	47.2
	88.0	-67	-51	1006	201	.63	352	25.1	30.0	35.0	40.0	44.9
14000.	97.8	-47	-25	1327	229	.71	416	23.8	27.6	31.4	35.1	38.9
	(1) 99.0	-57	-34	1442	240	.75	425	22.5	26.0	29.5	32.9	36.4
	97.5	-67	-45	1446	243	.75	420	22.1	25.6	29.0	32.5	35.9
	94.0	-47	-27	1159	214	.67	392	25.2	29.5	33.8	38.1	42.4
	94.0	-57	-37	1221	223	.70	397	24.3	28.4	32.5	36.6	40.7
	94.0	-67	-47	1285	231	.72	401	23.4	27.3	31.2	35.1	39.0
	92.0	-47	-29	1058	203	.64	373	25.8	30.6	35.3	40.0	44.7
	92.0	-57	-38	1133	214	.67	383	25.0	29.4	33.8	38.2	42.6
	92.0	-67	-48	1193	223	.70	388	24.2	28.4	32.5	36.7	40.9
	89.0	-47	-32	909	185	.59	342	26.6	32.1	37.6	43.1	48.6
	89.0	-57	-41	985	198	.62	356	26.0	31.1	36.2	41.2	46.3
	89.0	-67	-50	1062	210	.66	367	25.1	29.9	34.6	39.3	44.0
	86.0	-47	-35	781	162	.52	301	25.7	32.1	38.5	44.9	51.3
	(2) 86.0	-57	-44	841	178	.56	322	26.4	32.3	38.3	44.2	50.2
	86.0	-67	-52	913	192	.61	338	26.1	31.6	37.1	42.6	48.0
13000.	97.7	-47	-25	1327	230	.72	419	24.0	27.8	31.6	35.3	39.1
	(1) 99.0	-57	-34	1449	242	.75	428	22.6	26.1	29.5	33.0	36.5
	96.9	-67	-45	1422	243	.75	420	22.5	26.0	29.5	33.0	36.6
	94.0	-47	-27	1164	217	.68	396	25.4	29.7	34.0	38.3	42.6
	94.0	-57	-37	1226	225	.70	401	24.5	28.6	32.7	36.7	40.8
	94.0	-67	-46	1290	233	.73	404	23.6	27.5	31.3	35.2	39.1
	91.0	-47	-30	1012	201	.63	370	26.6	31.6	36.5	41.5	46.4
	91.0	-57	-39	1089	212	.67	380	25.7	30.3	34.9	39.5	44.1
	91.0	-67	-48	1155	221	.69	386	24.7	29.1	33.4	37.7	42.1
	88.0	-47	-32	873	184	.58	339	27.4	33.2	38.9	44.6	50.4
	88.0	-57	-41	940	196	.62	352	26.9	32.2	37.5	42.8	48.1
	88.0	-67	-50	1013	207	.65	363	25.9	30.9	35.8	40.7	45.7
	85.0	-47	-35	753	163	.52	303	26.9	33.5	40.2	46.8	53.4
	(2) 85.0	-57	-44	811	178	.56	322	27.3	33.5	39.7	45.8	52.0
	85.0	-67	-53	870	190	.60	335	27.0	32.7	38.5	44.2	49.9
12000.	97.7	-47	-24	1332	232	.73	422	24.2	27.9	31.7	35.5	39.2
	(1) 98.7	-57	-34	1440	243	.75	430	22.9	26.4	29.9	33.3	36.8
	96.4	-67	-45	1404	243	.75	420	22.8	26.4	29.9	33.5	37.0
	94.0	-47	-27	1168	219	.69	399	25.6	29.9	34.2	38.5	42.7
	94.0	-57	-36	1231	227	.71	404	24.7	28.7	32.8	36.9	40.9
	94.0	-67	-46	1295	235	.73	407	23.7	27.6	31.5	35.3	39.2
	90.0	-47	-30	971	199	.63	366	27.4	32.6	37.7	42.9	48.0
	90.0	-57	-39	1042	210	.66	376	26.5	31.3	36.1	40.9	45.7
	90.0	-67	-48	1116	219	.69	383	25.3	29.8	34.3	38.8	43.3
	86.0	-47	-33	799	177	.56	327	28.5	34.7	41.0	47.2	53.5
	86.0	-57	-42	857	188	.60	339	27.9	33.8	39.6	45.5	51.3
	86.0	-67	-51	924	200	.63	351	27.2	32.6	38.0	43.4	48.8
	83.0	-47	-36	692	156	.50	290	27.5	34.7	42.0	49.2	56.4
	(2) 83.0	-57	-45	738	169	.54	307	28.1	34.9	41.6	48.4	55.2
	83.0	-67	-54	792	182	.58	322	28.0	34.3	40.6	46.9	53.3

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-47°C	-57°C	-67°C
94.6	96.0	96.7
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 14 of 18)

CRUISE
39,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	98.1	-47	-27	1195	209	.69	400	25.1	29.3	33.5	37.6	41.8
	(1) 99.0	-57	-36	1293	220	.72	411	24.0	27.9	31.8	35.6	39.5
	99.0	-67	-45	1356	228	.74	414	23.1	26.8	30.5	34.2	37.9
	96.0	-47	-28	1112	200	.66	384	25.6	30.1	34.6	39.1	43.6
	96.0	-57	-37	1172	210	.69	393	25.0	29.3	33.5	37.8	42.1
	96.0	-67	-47	1230	218	.71	397	24.2	28.2	32.3	36.4	40.4
	95.0	-47	-29	1070	195	.64	376	25.8	30.4	35.1	39.8	44.4
	95.0	-57	-38	1129	205	.68	385	25.2	29.6	34.1	38.5	42.9
	95.0	-67	-48	1189	214	.70	391	24.5	28.7	32.9	37.1	41.3
	93.0	-47	-31	984	183	.61	353	25.7	30.8	35.9	41.0	46.0
	93.0	-57	-40	1047	195	.64	368	25.6	30.3	35.1	39.9	44.7
	93.0	-67	-49	1107	206	.68	377	25.0	29.5	34.1	38.6	43.1
	92.0	-47	-32	932	174	.58	337	25.5	30.9	36.2	41.6	47.0
	(2) 92.0	-57	-41	1005	189	.63	357	25.6	30.6	35.6	40.5	45.5
	92.0	-67	-50	1067	202	.66	370	25.3	30.0	34.6	39.3	44.0
15000.	97.9	-47	-26	1199	212	.70	405	25.5	29.7	33.8	38.0	42.2
	(1) 99.0	-57	-35	1304	224	.73	416	24.3	28.1	31.9	35.8	39.6
	99.0	-67	-45	1365	231	.75	418	23.3	27.0	30.6	34.3	38.0
	96.0	-47	-27	1122	205	.67	393	26.1	30.6	35.0	39.5	43.9
	96.0	-57	-37	1179	213	.70	398	25.3	29.5	33.8	38.0	42.3
	96.0	-67	-46	1239	221	.72	403	24.4	28.5	32.5	36.6	40.6
	94.0	-47	-29	1038	195	.64	375	26.5	31.3	36.1	40.9	45.7
	94.0	-57	-38	1097	205	.67	384	25.9	30.5	35.0	39.6	44.1
	94.0	-67	-48	1156	214	.70	390	25.1	29.4	33.8	38.1	42.4
	92.0	-47	-31	949	183	.61	354	26.7	32.0	37.3	42.5	47.8
	92.0	-57	-40	1015	195	.64	367	26.3	31.3	36.2	41.1	46.0
	92.0	-67	-49	1075	206	.68	376	25.7	30.4	35.0	39.7	44.3
	90.0	-47	-34	842	164	.55	320	26.1	32.0	38.0	43.9	49.8
	(2) 90.0	-57	-42	927	183	.61	346	26.6	32.0	37.4	42.8	48.2
	90.0	-67	-50	991	196	.65	360	26.2	31.3	36.3	41.4	46.4
14000.	97.9	-47	-26	1204	215	.71	411	25.8	30.0	34.1	38.3	42.4
	(1) 99.0	-57	-35	1311	226	.74	421	24.5	28.3	32.1	35.9	39.7
	98.4	-67	-45	1351	232	.75	420	23.7	27.4	31.1	34.8	38.5
	95.0	-47	-27	1088	204	.67	392	26.8	31.4	36.0	40.6	45.2
	95.0	-57	-37	1146	213	.70	397	25.9	30.3	34.7	39.0	43.4
	95.0	-67	-47	1204	220	.72	401	25.0	29.2	33.3	37.5	41.6
	93.0	-47	-29	1004	194	.64	374	27.3	32.3	37.3	42.2	47.2
	93.0	-57	-38	1064	204	.67	383	26.6	31.3	36.0	40.7	45.4
	93.0	-67	-48	1123	213	.70	389	25.8	30.2	34.7	39.1	43.6
	91.0	-47	-31	907	182	.60	352	27.7	33.3	38.8	44.3	49.8
	91.0	-57	-40	981	195	.64	366	27.2	32.2	37.3	42.4	47.5
	91.0	-67	-49	1038	204	.67	374	26.4	31.2	36.1	40.9	45.7
	89.0	-47	-34	811	166	.55	323	27.5	33.6	39.8	45.9	52.1
	(2) 89.0	-57	-42	888	182	.60	345	27.5	33.2	38.8	44.4	50.1
	89.0	-67	-50	961	196	.65	359	27.0	32.2	37.4	42.6	47.8
13000.	97.8	-47	-25	1207	217	.71	415	26.1	30.2	34.4	38.5	42.7
	(1) 99.0	-57	-34	1315	228	.75	424	24.7	28.5	32.3	36.1	39.9
	97.7	-67	-45	1326	232	.75	420	24.1	27.9	31.7	35.5	39.2
	95.0	-47	-27	1095	207	.68	397	27.2	31.7	36.3	40.9	45.4
	95.0	-57	-36	1152	215	.71	402	26.2	30.6	34.9	39.2	43.6
	95.0	-67	-46	1211	223	.73	406	25.2	29.4	33.5	37.6	41.8
	92.0	-47	-29	964	193	.64	372	28.2	33.4	38.6	43.8	49.0
	92.0	-57	-38	1030	203	.67	381	27.3	32.2	37.0	41.9	46.7
	92.0	-67	-48	1089	212	.70	388	26.4	31.0	35.6	40.2	44.8
	89.0	-47	-32	825	174	.58	338	28.8	34.9	41.0	47.0	53.1
	89.0	-57	-41	895	188	.62	354	28.4	33.9	39.5	45.1	50.7
	89.0	-67	-50	967	199	.66	366	27.5	32.6	37.8	43.0	48.1
	87.0	-47	-35	744	159	.53	310	28.3	35.0	41.7	48.4	55.1
	(2) 87.0	-57	-43	803	174	.58	330	28.7	34.9	41.1	47.3	53.6
	87.0	-67	-52	874	188	.62	346	28.2	33.9	39.6	45.4	51.1
12000.	97.8	-47	-25	1211	220	.72	419	26.3	30.5	34.6	38.7	42.8
	(1) 99.0	-57	-34	1321	231	.75	428	24.8	28.6	32.4	36.2	40.0
	97.0	-67	-45	1302	232	.75	420	24.6	28.4	32.3	36.1	39.9
	94.0	-47	-27	1060	206	.68	395	27.9	32.6	37.3	42.0	46.7
	94.0	-57	-37	1117	214	.70	400	26.9	31.3	35.8	40.3	44.8
	94.0	-67	-46	1176	222	.73	404	25.9	30.1	34.4	38.6	42.9
	91.0	-47	-30	922	191	.63	369	29.1	34.6	40.0	45.4	50.8
	91.0	-57	-39	992	202	.67	379	28.1	33.2	38.2	43.2	48.3
	91.0	-67	-48	1051	211	.69	385	27.1	31.9	36.6	41.4	46.2
	88.0	-47	-32	793	174	.58	337	29.9	36.2	42.5	48.9	55.2
	88.0	-57	-41	856	186	.62	351	29.3	35.2	41.0	46.9	52.7
	88.0	-67	-50	923	197	.65	362	28.4	33.8	39.2	44.6	50.0
	85.0	-47	-35	684	153	.51	299	29.1	36.4	43.7	51.0	58.4
	(2) 85.0	-57	-44	734	167	.56	318	29.7	36.5	43.3	50.1	56.9
	85.0	-67	-53	792	180	.60	333	29.4	35.8	42.1	48.4	54.7

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-47°C	-57°C	-67°C
94.7	96.1	97.5
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 15 of 18)

CRUISE
41,000 FEET

ANTI-ICE SYSTEMS OFF | **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	98.3	-47	-28	1079	192	.66	387	26.6	31.3	35.9	40.5	45.2
	(1) 99.0	-57	-37	1167	205	.70	401	25.8	30.1	34.4	38.7	42.9
	99.0	-67	-46	1228	213	.73	406	24.9	29.0	33.1	37.2	41.2
	97.0	-47	-29	1032	187	.65	377	26.8	31.7	36.5	41.4	46.2
	97.0	-57	-38	1089	197	.68	388	26.4	31.0	35.6	40.2	44.8
	97.0	-67	-47	1148	206	.71	394	25.6	29.9	34.3	38.6	43.0
	96.0	-47	-30	993	181	.63	367	26.8	31.9	36.9	42.0	47.0
	96.0	-57	-39	1050	192	.66	379	26.5	31.3	36.1	40.8	45.6
	96.0	-67	-48	1108	202	.70	387	25.9	30.4	35.0	39.5	44.0
	95.0	-47	-31	955	175	.61	354	26.6	31.9	37.1	42.4	47.6
	(2) 95.0	-57	-40	1012	188	.65	370	26.7	31.6	36.5	41.5	46.4
	95.0	-67	-49	1068	198	.68	380	26.2	30.9	35.6	40.2	44.9
15000.	98.1	-47	-27	1087	197	.68	397	27.3	31.9	36.5	41.1	45.7
	(1) 99.0	-57	-36	1174	209	.72	408	26.2	30.5	34.7	39.0	43.3
	99.0	-67	-45	1237	216	.74	412	25.2	29.2	33.3	37.3	41.4
	96.0	-47	-29	1009	189	.65	380	27.8	32.7	37.7	42.6	47.6
	96.0	-57	-38	1063	198	.68	389	27.2	31.9	36.6	41.3	46.0
	96.0	-67	-47	1118	207	.71	395	26.4	30.8	35.3	39.8	44.3
	95.0	-47	-30	970	183	.63	370	27.8	33.0	38.2	43.3	48.5
	95.0	-57	-39	1024	193	.67	380	27.4	32.3	37.1	42.0	46.9
	95.0	-67	-48	1080	203	.70	388	26.7	31.3	36.0	40.6	45.2
	94.0	-47	-31	930	177	.61	358	27.8	33.1	38.5	43.9	49.3
	94.0	-57	-39	988	189	.65	372	27.6	32.6	37.7	42.8	47.8
	94.0	-67	-49	1042	199	.68	381	27.0	31.8	36.6	41.4	46.2
	93.0	-47	-32	887	170	.59	344	27.6	33.2	38.8	44.5	50.1
	(2) 93.0	-57	-40	949	183	.64	362	27.7	32.9	38.2	43.5	48.7
	93.0	-67	-49	1005	195	.67	374	27.2	32.2	37.2	42.2	47.1
14000.	98.0	-47	-26	1094	201	.69	404	27.8	32.4	36.9	41.5	46.1
	(1) 99.0	-57	-35	1186	212	.73	414	26.5	30.7	35.0	39.2	43.4
	99.0	-67	-45	1246	219	.75	417	25.4	29.5	33.5	37.5	41.5
	96.0	-47	-28	1020	194	.67	390	28.5	33.4	38.3	43.2	48.1
	96.0	-57	-37	1073	202	.70	397	27.7	32.3	37.0	41.7	46.3
	96.0	-67	-47	1126	210	.72	401	26.7	31.1	35.6	40.0	44.5
	94.0	-47	-29	943	184	.64	372	28.9	34.2	39.5	44.8	50.1
	94.0	-57	-38	997	194	.67	381	28.2	33.2	38.2	43.2	48.3
	94.0	-67	-48	1051	203	.70	388	27.4	32.2	36.9	41.7	46.5
	92.0	-47	-31	860	172	.60	348	28.9	34.7	40.5	46.3	52.1
	92.0	-57	-40	921	184	.64	364	28.6	34.1	39.5	44.9	50.4
	92.0	-67	-49	977	195	.67	374	28.0	33.2	38.3	43.4	48.5
	91.0	-47	-33	808	162	.57	330	28.5	34.7	40.9	47.1	53.3
	(2) 91.0	-57	-41	883	179	.62	353	28.7	34.4	40.0	45.7	51.4
	91.0	-67	-50	940	190	.66	366	28.3	33.6	38.9	44.3	49.6
13000.	97.9	-47	-26	1096	204	.70	409	28.2	32.8	37.3	41.9	46.5
	(1) 99.0	-57	-35	1191	215	.74	419	26.8	31.0	35.2	39.4	43.6
	98.6	-67	-45	1239	221	.75	420	25.8	29.9	33.9	37.9	42.0
	95.0	-47	-28	990	194	.67	390	29.3	34.3	39.4	44.4	49.5
	95.0	-57	-37	1044	202	.70	397	28.4	33.2	38.0	42.8	47.6
	95.0	-67	-47	1096	210	.72	400	27.4	31.9	36.5	41.1	45.6
	93.0	-47	-29	913	184	.64	372	29.7	35.2	40.7	46.2	51.6
	93.0	-57	-38	968	194	.67	381	29.1	34.2	39.4	44.6	49.7
	93.0	-67	-48	1022	203	.70	388	28.2	33.1	38.0	42.9	47.7
	91.0	-47	-32	823	171	.60	348	30.1	36.2	42.2	48.3	54.4
	91.0	-57	-40	892	184	.64	364	29.6	35.2	40.8	46.4	52.0
	91.0	-67	-49	948	194	.67	373	28.9	34.1	39.4	44.7	50.0
	89.0	-47	-34	735	155	.54	317	29.5	36.3	43.1	49.9	56.7
	(2) 89.0	-57	-42	805	172	.60	341	29.9	36.1	42.4	48.6	54.8
	89.0	-67	-51	873	185	.64	357	29.4	35.2	40.9	46.6	52.3
12000.	97.8	-47	-25	1098	207	.71	414	28.6	33.2	37.7	42.3	46.8
	(1) 99.0	-57	-34	1198	218	.75	424	27.0	31.2	35.4	39.5	43.7
	97.8	-67	-45	1212	221	.75	420	26.4	30.5	34.6	38.8	42.9
	95.0	-47	-27	997	197	.68	396	29.7	34.8	39.8	44.8	49.8
	95.0	-57	-37	1050	205	.71	401	28.7	33.5	38.3	43.0	47.8
	95.0	-67	-46	1103	213	.73	405	27.7	32.2	36.7	41.3	45.8
	92.0	-47	-30	877	183	.63	370	30.8	36.5	42.2	47.9	53.6
	92.0	-57	-39	937	193	.67	380	29.9	35.3	40.6	45.9	51.3
	92.0	-67	-48	992	202	.70	387	28.9	34.0	39.0	44.1	49.1
	89.0	-47	-32	751	165	.58	336	31.4	38.1	44.7	51.4	58.1
	89.0	-57	-41	814	178	.62	352	31.0	37.1	43.3	49.4	55.6
	89.0	-67	-50	880	189	.65	364	30.0	35.7	41.4	47.1	52.8
	87.0	-47	-35	675	149	.52	305	30.4	37.8	45.2	52.7	60.1
	(2) 87.0	-57	-43	729	165	.57	328	31.2	38.1	44.9	51.8	58.6
	87.0	-67	-52	795	178	.62	345	30.8	37.1	43.4	49.7	55.9

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

ANTI-ICE SYSTEMS ON		
MAX. FAN %RPM		
-47°C	-57°C	-67°C
94.8	96.1	97.6
INCREASE FUEL FLOWS AND DECREASE SPECIFIC RANGES BY 6%		

Figure 7-22 Cruise (Sheet 16 of 18)

CRUISE
43,000 FEET

ANTI-ICE SYSTEMS OFF — **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	98.5	-47	-30	967	173	.63	367	27.6	32.8	38.0	43.1	48.3
	(1) 99.0	-57	-38	1041	187	.67	384	27.3	32.1	36.9	41.7	46.5
	99.0	-67	-47	1104	197	.71	394	26.6	31.1	35.7	40.2	44.7
15000.	98.3	-47	-28	980	181	.66	383	28.8	33.9	39.0	44.1	49.2
	(1) 99.0	-57	-37	1058	193	.70	397	28.1	32.8	37.5	42.2	47.0
	99.0	-67	-46	1117	202	.72	403	27.1	31.6	36.0	40.5	45.0
	97.0	-47	-30	933	175	.63	370	28.9	34.3	39.6	45.0	50.3
	97.0	-57	-38	987	186	.67	383	28.7	33.7	38.8	43.9	48.9
	97.0	-67	-48	1042	194	.70	390	27.8	32.6	37.4	42.2	47.0
	96.0	-47	-31	896	168	.61	357	28.7	34.3	39.9	45.4	51.0
	(2) 96.0	-57	-39	951	181	.66	373	28.7	34.0	39.3	44.5	49.8
	96.0	-67	-48	1005	191	.69	383	28.2	33.1	38.1	43.1	48.1
14000.	98.2	-47	-27	989	187	.68	394	29.7	34.8	39.8	44.9	49.9
	(1) 99.0	-57	-36	1068	198	.71	406	28.6	33.3	38.0	42.6	47.3
	99.0	-67	-46	1127	205	.74	410	27.5	31.9	36.4	40.8	45.3
	97.0	-47	-28	948	182	.66	384	30.0	35.3	40.5	45.8	51.1
	97.0	-57	-37	1000	191	.69	393	29.4	34.4	39.4	44.4	49.4
	97.0	-67	-47	1052	199	.72	398	28.3	33.1	37.8	42.6	47.3
	96.0	-47	-29	916	178	.65	376	30.1	35.6	41.0	46.5	52.0
	96.0	-57	-38	965	187	.68	385	29.6	34.8	40.0	45.1	50.3
	96.0	-67	-47	1017	196	.71	392	28.7	33.7	38.6	43.5	48.4
	95.0	-47	-30	879	172	.62	364	30.0	35.7	41.4	47.1	52.8
	95.0	-57	-39	930	183	.66	377	29.8	35.2	40.5	45.9	51.3
	95.0	-67	-48	980	192	.69	385	29.1	34.2	39.3	44.4	49.5
	94.0	-47	-31	842	165	.60	352	29.9	35.8	41.8	47.7	53.7
	(2) 94.0	-57	-40	896	178	.65	368	29.9	35.5	41.1	46.6	52.2
	94.0	-67	-49	946	188	.68	378	29.4	34.7	40.0	45.3	50.5
13000.	98.0	-47	-26	994	191	.69	402	30.4	35.4	40.4	45.5	50.5
	(1) 99.0	-57	-35	1079	202	.73	413	29.0	33.6	38.3	42.9	47.5
	99.0	-67	-45	1136	209	.75	416	27.8	32.2	36.6	41.0	45.4
	96.0	-47	-28	927	184	.66	387	31.0	36.4	41.8	47.2	52.6
	96.0	-57	-37	976	192	.69	395	30.2	35.4	40.5	45.6	50.7
	96.0	-67	-47	1025	200	.72	399	29.2	34.1	38.9	43.8	48.7
	95.0	-47	-29	891	179	.65	378	31.2	36.8	42.4	48.0	53.6
	95.0	-57	-38	941	188	.68	387	30.5	35.8	41.1	46.5	51.8
	95.0	-67	-47	990	196	.71	393	29.6	34.7	39.7	44.8	49.8
	93.0	-47	-31	820	168	.61	357	31.3	37.4	43.5	49.6	55.7
	93.0	-57	-39	872	179	.65	370	31.0	36.7	42.5	48.2	54.0
	93.0	-67	-49	922	189	.68	379	30.3	35.7	41.1	46.6	52.0
	92.0	-47	-32	780	161	.59	343	31.2	37.6	44.0	50.4	56.8
	(2) 92.0	-57	-40	837	174	.63	360	31.1	37.1	43.1	49.1	55.0
	92.0	-67	-49	889	185	.67	372	30.6	36.2	41.9	47.5	53.1
12000.	97.9	-47	-26	1001	195	.70	409	30.9	35.9	40.9	45.9	50.9
	(1) 99.0	-57	-35	1086	205	.74	419	29.3	33.9	38.5	43.1	47.7
	98.7	-67	-45	1134	211	.75	420	28.2	32.6	37.0	41.4	45.9
	96.0	-47	-27	936	188	.68	396	31.7	37.0	42.3	47.7	53.0
	96.0	-57	-37	983	196	.71	401	30.7	35.7	40.8	45.9	51.0
	96.0	-67	-46	1033	203	.73	406	29.6	34.4	39.3	44.1	48.9
	94.0	-47	-29	865	179	.65	379	32.2	38.0	43.8	49.6	55.4
	94.0	-57	-38	916	188	.68	388	31.4	36.9	42.4	47.8	53.3
	94.0	-67	-47	964	196	.71	393	30.4	35.6	40.8	46.0	51.2
	92.0	-47	-30	793	169	.62	359	32.7	39.0	45.3	51.6	57.9
	92.0	-57	-39	846	180	.65	371	32.1	38.0	43.9	49.8	55.7
	92.0	-67	-49	897	189	.68	380	31.2	36.8	42.4	47.9	53.5
	90.0	-47	-33	709	155	.57	331	32.5	39.6	46.6	53.7	60.7
	(2) 90.0	-57	-41	774	169	.62	351	32.5	38.9	45.4	51.8	58.3
	90.0	-67	-50	826	180	.65	364	31.9	38.0	44.0	50.1	56.1

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-22 Cruise (Sheet 17 of 18)

CRUISE
45,000 FEET

ANTI-ICE SYSTEMS OFF **TWO ENGINES**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.												
	(1) 99.0	-57	-42	911	160	.61	347	27.2	32.7	38.1	43.6	49.1
	99.0	-67	-49	975	175	.67	370	27.7	32.9	38.0	43.1	48.3
15000.	98.6	-47	-31	874	160	.61	356	29.3	35.0	40.7	46.4	52.1
	(1) 99.0	-57	-39	942	174	.66	377	29.4	34.7	40.0	45.3	50.6
	99.0	-67	-48	998	184	.70	388	28.8	33.9	38.9	43.9	48.9
14000.	98.3	-47	-29	888	170	.65	377	31.2	36.8	42.5	48.1	53.7
	(1) 99.0	-57	-37	961	182	.69	393	30.5	35.7	40.9	46.1	51.3
	99.0	-67	-47	1015	190	.72	399	29.5	34.4	39.4	44.3	49.2
	97.0	-47	-30	844	163	.62	363	31.1	37.0	43.0	48.9	54.8
	(2) 97.0	-57	-39	894	175	.66	378	31.1	36.7	42.2	47.8	53.4
	97.0	-67	-48	946	184	.69	386	30.2	35.5	40.8	46.1	51.4
13000.	98.2	-47	-28	898	177	.67	391	32.4	37.9	43.5	49.1	54.6
	(1) 99.0	-57	-36	974	188	.71	404	31.2	36.3	41.4	46.6	51.7
	99.0	-67	-46	1025	195	.73	408	30.0	34.9	39.8	44.7	49.6
	97.0	-47	-29	861	172	.65	381	32.6	38.4	44.2	50.0	55.8
	97.0	-57	-38	909	181	.69	391	32.0	37.5	43.0	48.6	54.1
	97.0	-67	-47	958	189	.71	396	30.9	36.1	41.3	46.6	51.8
	96.0	-47	-29	832	167	.64	372	32.7	38.7	44.7	50.7	56.7
	96.0	-57	-38	876	177	.67	382	32.2	37.9	43.6	49.3	55.0
	96.0	-67	-48	925	185	.70	390	31.4	36.8	42.2	47.6	53.0
	95.0	-47	-30	799	162	.62	360	32.5	38.8	45.0	51.3	57.6
	95.0	-57	-39	845	173	.66	374	32.4	38.3	44.2	50.2	56.1
	95.0	-67	-48	891	182	.69	383	31.8	37.4	43.0	48.6	54.2
	94.0	-47	-32	762	155	.59	345	32.2	38.7	45.3	51.8	58.4
	(2) 94.0	-57	-40	813	168	.64	364	32.5	38.6	44.8	50.9	57.0
	94.0	-67	-49	860	178	.67	376	32.1	37.9	43.7	49.5	55.3
12000.	98.1	-47	-27	907	182	.69	401	33.2	38.7	44.2	49.7	55.2
	(1) 99.0	-57	-35	985	192	.72	412	31.7	36.8	41.8	46.9	52.0
	99.0	-67	-45	1034	199	.75	415	30.4	35.3	40.1	45.0	49.8
	96.0	-47	-28	844	174	.66	386	33.8	39.8	45.7	51.6	57.5
	96.0	-57	-37	888	183	.69	393	33.0	38.7	44.3	49.9	55.6
	96.0	-67	-47	934	190	.72	398	31.9	37.3	42.6	48.0	53.3
	95.0	-47	-29	812	170	.65	377	34.1	40.2	46.4	52.5	58.7
	95.0	-57	-38	857	179	.68	386	33.4	39.2	45.0	50.9	56.7
	95.0	-67	-47	901	187	.71	392	32.4	38.0	43.5	49.1	54.6
	93.0	-47	-31	745	159	.61	354	34.0	40.7	47.5	54.2	60.9
	93.0	-57	-40	794	170	.65	369	33.8	40.1	46.4	52.7	59.0
	93.0	-67	-49	839	179	.68	378	33.1	39.1	45.0	51.0	56.9
	92.0	-47	-32	708	152	.58	339	33.7	40.8	47.9	54.9	62.0
	(2) 92.0	-57	-41	761	165	.63	358	33.9	40.5	47.1	53.6	60.2
	92.0	-67	-49	809	175	.67	371	33.4	39.6	45.8	52.0	58.1

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM
RANGE (APPROXIMATE)

Figure 7-22 Cruise (Sheet 18 of 18)

CRUISE
5000 FEET

ANTI-ICE SYSTEMS OFF | **ONE ENGINE**

WT. LBS.		FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.		90.2	15	23	1260	227	.38	247	11.6	15.6	19.6	23.5	27.5
	(1)	91.7	5	13	1364	242	.40	259	11.6	15.3	19.0	22.6	26.3
		93.2	-5	4	1465	256	.42	268	11.5	14.9	18.3	21.7	25.1
		85.0	15	21	1045	198	.33	216	11.1	15.9	20.7	25.4	30.2
		85.0	5	11	1081	208	.35	222	11.3	15.9	20.5	25.2	29.8
		85.0	-5	1	1121	216	.36	227	11.3	15.8	20.2	24.7	29.2
		81.0	15	19	907	172	.29	187	9.6	15.1	20.6	26.1	31.6
	(2)	81.0	5	10	930	181	.30	194	10.1	15.5	20.8	26.2	31.6
		81.0	-5	0	963	192	.32	201	10.5	15.7	20.9	26.1	31.3
15000.		90.2	15	23	1261	229	.38	249	11.8	15.8	19.7	23.7	27.7
	(1)	91.7	5	14	1366	244	.40	261	11.8	15.4	19.1	22.8	26.4
		93.2	-5	4	1466	258	.43	270	11.6	15.0	18.4	21.8	25.2
		84.0	15	21	1007	196	.33	213	11.2	16.2	21.2	26.1	31.1
		84.0	5	11	1047	206	.34	220	11.5	16.2	21.0	25.8	30.6
		84.0	-5	1	1080	213	.35	224	11.5	16.1	20.7	25.4	30.0
		79.0	15	19	858	167	.28	182	9.5	15.4	21.2	27.0	32.8
	(2)	79.0	5	9	874	175	.29	187	9.9	15.7	21.4	27.1	32.8
		79.0	-5	0	890	182	.30	191	10.2	15.9	21.5	27.1	32.7
14000.		90.2	15	23	1262	232	.38	252	12.0	16.0	19.9	23.9	27.9
	(1)	91.7	5	14	1364	246	.41	262	11.9	15.6	19.2	22.9	26.6
		93.2	-5	4	1467	259	.43	271	11.7	15.1	18.5	21.9	25.3
		83.0	15	21	971	193	.32	211	11.4	16.6	21.7	26.9	32.0
		83.0	5	11	1007	202	.34	216	11.5	16.5	21.5	26.4	31.4
		83.0	-5	1	1042	210	.35	221	11.6	16.4	21.2	26.0	30.8
		77.0	15	19	810	162	.27	176	9.4	15.6	21.8	28.0	34.1
	(2)	77.0	5	9	825	169	.28	181	9.9	15.9	22.0	28.1	34.1
		77.0	-5	-1	841	176	.30	186	10.2	16.1	22.1	28.0	34.0
13000.		90.1	15	23	1259	233	.39	253	12.2	16.1	20.1	24.1	28.0
	(1)	91.6	5	14	1362	247	.41	263	12.0	15.7	19.3	23.0	26.7
		93.2	-5	4	1468	260	.43	272	11.7	15.2	18.6	22.0	25.4
		82.0	15	20	936	191	.32	208	11.6	16.9	22.3	27.6	32.9
		82.0	5	11	966	199	.33	213	11.7	16.8	22.0	27.2	32.4
		82.0	-5	1	1002	207	.34	217	11.7	16.7	21.7	26.7	31.6
		74.0	15	19	746	152	.26	166	8.8	15.5	22.2	28.9	35.6
	(2)	74.0	5	9	754	159	.27	170	9.3	15.9	22.6	29.2	35.8
		74.0	-5	-1	768	166	.28	175	9.7	16.2	22.8	29.3	35.8
12000.		90.2	15	23	1260	234	.39	255	12.3	16.3	20.2	24.2	28.2
	(1)	91.6	5	14	1362	248	.41	265	12.1	15.8	19.4	23.1	26.8
		93.1	-5	4	1466	262	.43	274	11.9	15.3	18.7	22.1	25.5
		81.0	15	20	911	190	.32	207	11.8	17.3	22.7	28.2	33.7
		81.0	5	11	928	196	.33	209	11.8	17.2	22.6	28.0	33.3
		81.0	-5	1	963	203	.34	214	11.8	17.0	22.2	27.4	32.6
		72.0	15	18	710	150	.25	164	9.0	16.0	23.0	30.1	37.1
	(2)	72.0	5	9	718	156	.26	167	9.3	16.3	23.3	30.2	37.2
		72.0	-5	-1	726	162	.27	170	9.6	16.5	23.4	30.3	37.2

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23 Cruise (Sheet 1 of 10)

CRUISE
10,000 FEET

ANTI-ICE SYSTEMS OFF **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	91.8	5	13	1136	214	.39	251	13.3	17.7	22.1	26.5	30.9
	(1) 93.2	-5	4	1214	227	.41	261	13.3	17.4	21.5	25.6	29.7
	94.8	-15	-5	1346	245	.44	276	13.0	16.8	20.5	24.2	27.9
	88.0	5	12	1004	195	.36	229	12.9	17.9	22.8	27.8	32.8
	88.0	-5	2	1036	204	.37	235	13.1	17.9	22.7	27.6	32.4
	88.0	-15	-8	1069	212	.39	239	13.0	17.7	22.4	27.1	31.8
	84.0	5	10	871	168	.31	198	11.3	17.0	22.7	28.5	34.2
	(2) 84.0	-5	1	900	180	.33	207	11.9	17.5	23.0	28.6	34.1
	84.0	-15	-9	932	190	.35	215	12.4	17.7	23.1	28.5	33.8
15000.	91.8	5	13	1137	216	.39	254	13.5	17.9	22.3	26.7	31.1
	(1) 93.2	-5	4	1216	230	.42	264	13.5	17.6	21.7	25.8	29.9
	94.7	-15	-5	1345	246	.45	277	13.2	16.9	20.6	24.3	28.1
	87.0	5	12	971	194	.35	227	13.1	18.3	23.4	28.6	33.7
	87.0	-5	2	1002	202	.37	233	13.3	18.2	23.2	28.2	33.2
	87.0	-15	-8	1034	210	.38	237	13.3	18.1	22.9	27.8	32.6
	83.0	5	10	841	169	.31	198	11.7	17.6	23.6	29.5	35.5
	(2) 83.0	-5	0	869	179	.33	206	12.2	18.0	23.7	29.5	35.2
	83.0	-15	-9	899	189	.34	213	12.6	18.2	23.7	29.3	34.9
14000.	91.7	5	13	1134	219	.40	257	13.8	18.2	22.6	27.0	31.4
	(1) 93.3	-5	4	1220	232	.42	267	13.7	17.8	21.9	26.0	30.1
	94.6	-15	-5	1345	248	.45	279	13.3	17.0	20.7	24.5	28.2
	86.0	5	11	937	192	.35	225	13.4	18.7	24.0	29.4	34.7
	86.0	-5	2	967	200	.36	230	13.5	18.6	23.8	29.0	34.2
	86.0	-15	-8	1002	208	.38	235	13.5	18.5	23.5	28.4	33.4
	81.0	5	10	778	160	.29	188	11.3	17.8	24.2	30.6	37.0
	(2) 81.0	-5	0	806	171	.31	197	12.1	18.3	24.5	30.7	36.9
	81.0	-15	-10	834	180	.33	204	12.5	18.5	24.5	30.5	36.5
13000.	91.7	5	14	1136	221	.40	259	14.0	18.4	22.8	27.2	31.6
	(1) 93.3	-5	4	1222	234	.42	269	13.8	17.9	22.0	26.1	30.2
	94.7	-15	-5	1348	249	.45	281	13.4	17.1	20.8	24.5	28.2
	85.0	5	11	904	190	.35	223	13.6	19.2	24.7	30.2	35.7
	85.0	-5	2	935	198	.36	228	13.7	19.1	24.4	29.7	35.1
	85.0	-15	-8	968	205	.37	232	13.7	18.8	24.0	29.2	34.3
	79.0	5	9	729	154	.28	181	11.2	18.0	24.9	31.8	38.6
	(2) 79.0	-5	0	745	163	.30	188	11.8	18.6	25.3	32.0	38.7
	79.0	-15	-10	772	173	.32	195	12.4	18.8	25.3	31.8	38.3
12000.	91.7	5	14	1134	223	.40	261	14.2	18.6	23.0	27.4	31.8
	(1) 93.2	-5	4	1223	235	.43	271	13.9	18.0	22.1	26.2	30.3
	94.6	-15	-5	1347	250	.45	282	13.5	17.2	20.9	24.6	28.3
	83.0	5	11	841	183	.33	215	13.7	19.6	25.6	31.5	37.5
	83.0	-5	1	871	191	.35	220	13.8	19.5	25.3	31.0	36.8
	83.0	-15	-9	900	198	.36	224	13.8	19.3	24.9	30.4	36.0
	76.0	5	9	668	146	.27	171	10.7	18.2	25.6	33.1	40.6
	(2) 76.0	-5	-1	681	154	.28	177	11.4	18.7	26.0	33.4	40.7
	76.0	-15	-11	695	161	.30	182	11.8	19.0	26.2	33.4	40.6

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23. Cruise (Sheet 2 of 10)

CRUISE
15,000 FEET

ANTI-ICE SYSTEMS OFF **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	93.4	-5	3	1009	198	.40	251	15.0	19.9	24.9	29.8	34.8
	(1) 94.8	-15	-6	1111	215	.43	267	15.0	19.5	24.0	28.5	33.0
	96.2	-25	-15	1243	232	.46	283	14.7	18.7	22.7	26.8	30.8
	90.0	-5	2	909	181	.36	230	14.3	19.8	25.3	30.8	36.3
	90.0	-15	-8	936	190	.38	237	14.6	20.0	25.3	30.7	36.0
	90.0	-25	-17	967	199	.40	243	14.8	19.9	25.1	30.3	35.4
	88.0	-5	1	854	169	.34	214	13.4	19.2	25.1	31.0	36.8
	(2) 88.0	-15	-9	880	179	.36	223	14.0	19.6	25.3	31.0	36.7
	88.0	-25	-18	907	188	.38	230	14.4	19.9	25.4	30.9	36.4
15000.	93.4	-5	3	1007	201	.40	255	15.4	20.4	25.3	30.3	35.3
	(1) 94.7	-15	-6	1111	218	.43	270	15.3	19.8	24.3	28.8	33.3
	96.2	-25	-15	1242	234	.47	285	14.9	18.9	22.9	27.0	31.0
	90.0	-5	2	909	186	.37	236	15.0	20.5	26.0	31.5	37.0
	90.0	-15	-7	938	195	.39	243	15.2	20.5	25.9	31.2	36.5
	90.0	-25	-17	967	202	.40	247	15.2	20.4	25.5	30.7	35.9
	87.0	-5	1	827	169	.34	215	13.9	20.0	26.0	32.1	38.1
	(2) 87.0	-15	-8	855	180	.36	224	14.5	20.3	26.2	32.0	37.9
	87.0	-25	-18	880	188	.38	230	14.7	20.4	26.1	31.8	37.5
14000.	93.3	-5	4	1008	204	.41	259	15.8	20.7	25.7	30.6	35.6
	(1) 94.8	-15	-5	1115	220	.44	274	15.6	20.1	24.5	29.0	33.5
	96.1	-25	-14	1243	236	.47	287	15.1	19.1	23.1	27.1	31.2
	89.0	-5	2	885	186	.37	237	15.4	21.1	26.7	32.4	38.0
	89.0	-15	-7	911	194	.39	241	15.5	21.0	26.5	32.0	37.5
	89.0	-25	-17	938	201	.40	245	15.5	20.8	26.1	31.5	36.8
	85.0	-5	1	772	164	.33	208	14.0	20.5	26.9	33.4	39.9
	(2) 85.0	-15	-9	798	173	.35	216	14.5	20.8	27.0	33.3	39.6
	85.0	-25	-19	826	183	.37	223	14.9	21.0	27.0	33.1	39.1
13000.	93.2	-5	4	1007	207	.41	262	16.1	21.0	26.0	31.0	35.9
	(1) 94.8	-15	-5	1116	222	.44	276	15.8	20.3	24.7	29.2	33.7
	96.1	-25	-14	1244	238	.47	289	15.2	19.2	23.2	27.3	31.3
	88.0	-5	2	857	186	.37	236	15.8	21.7	27.5	33.3	39.2
	88.0	-15	-8	884	193	.39	240	15.9	21.5	27.2	32.9	38.5
	88.0	-25	-17	911	200	.40	244	15.8	21.3	26.8	32.3	37.7
	83.0	-5	0	719	158	.32	201	14.0	21.0	27.9	34.9	41.8
	(2) 83.0	-15	-9	744	167	.34	209	14.6	21.3	28.0	34.8	41.5
	83.0	-25	-19	770	176	.35	216	15.0	21.5	28.0	34.5	41.0
12000.	93.3	-5	4	1010	210	.42	266	16.4	21.3	26.3	31.2	36.2
	(1) 94.6	-15	-5	1114	224	.45	278	16.0	20.5	25.0	29.4	33.9
	96.1	-25	-14	1249	240	.48	292	15.4	19.4	23.4	27.4	31.4
	87.0	-5	2	830	184	.37	234	16.2	22.2	28.2	34.3	40.3
	87.0	-15	-8	858	192	.38	239	16.2	22.0	27.8	33.7	39.5
	87.0	-25	-17	883	198	.40	242	16.1	21.7	27.4	33.1	38.7
	81.0	-5	0	669	152	.31	193	14.0	21.4	28.9	36.4	43.9
	(2) 81.0	-15	-10	691	161	.32	201	14.6	21.9	29.1	36.3	43.6
	81.0	-25	-19	715	170	.34	208	15.1	22.1	29.1	36.1	43.1

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23. Cruise (Sheet 3 of 10)

CRUISE
17,000 FEET

ANTI-ICE SYSTEMS OFF **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	94.0	-9	-1	970	192	.40	251	15.6	20.7	25.9	31.0	36.2
	(1) 95.4	-19	-10	1068	209	.43	268	15.7	20.4	25.1	29.8	34.5
	96.8	-29	-19	1198	227	.47	285	15.4	19.6	23.8	27.9	32.1
	92.0	-9	-2	904	181	.38	237	15.1	20.7	26.2	31.7	37.3
	92.0	-19	-11	942	191	.40	246	15.5	20.8	26.1	31.4	36.7
	92.0	-29	-21	979	200	.42	252	15.5	20.6	25.7	30.8	35.9
	90.0	-9	-3	850	168	.35	220	14.1	20.0	25.9	31.8	37.7
	(2) 90.0	-19	-12	876	179	.37	230	14.8	20.5	26.2	31.9	37.6
	90.0	-29	-22	912	190	.40	239	15.2	20.7	26.2	31.7	37.2
15000.	93.9	-9	-1	967	195	.41	256	16.1	21.3	26.4	31.6	36.8
	(1) 95.3	-19	-9	1073	212	.44	272	16.1	20.7	25.4	30.0	34.7
	96.8	-29	-18	1202	230	.47	288	15.6	19.8	23.9	28.1	32.3
	91.0	-9	-2	879	181	.38	238	15.7	21.4	27.1	32.8	38.4
	91.0	-19	-11	906	190	.40	244	15.9	21.4	26.9	32.4	38.0
	91.0	-29	-21	944	199	.41	250	15.9	21.2	26.5	31.8	37.1
	88.0	-9	-3	803	164	.34	216	14.4	20.7	26.9	33.1	39.4
	(2) 88.0	-19	-12	825	174	.36	224	15.0	21.1	27.1	33.2	39.2
	88.0	-29	-22	850	183	.38	231	15.4	21.3	27.2	33.1	38.9
14000.	93.9	-9	0	967	199	.41	260	16.5	21.7	26.9	32.1	37.2
	(1) 95.3	-19	-9	1074	215	.45	275	16.3	21.0	25.7	30.3	35.0
	96.7	-29	-18	1203	232	.48	290	15.8	20.0	24.1	28.3	32.4
	90.0	-9	-2	854	182	.38	238	16.2	22.0	27.9	33.8	39.6
	90.0	-19	-11	879	189	.39	243	16.3	22.0	27.7	33.4	39.1
	90.0	-29	-21	912	198	.41	249	16.3	21.8	27.3	32.7	38.2
	86.0	-9	-3	750	159	.33	208	14.4	21.1	27.8	34.4	41.1
	(2) 86.0	-19	-13	775	169	.35	218	15.2	21.6	28.1	34.5	41.0
	86.0	-29	-22	800	178	.37	225	15.6	21.9	28.1	34.4	40.6
13000.	93.8	-9	0	967	202	.42	264	17.0	22.1	27.3	32.5	37.6
	(1) 95.3	-19	-9	1075	217	.45	279	16.6	21.3	25.9	30.6	35.2
	96.7	-29	-18	1204	233	.48	293	16.0	20.1	24.3	28.4	32.6
	89.0	-9	-2	831	182	.38	238	16.6	22.7	28.7	34.7	40.7
	89.0	-19	-11	854	189	.39	243	16.8	22.6	28.5	34.3	40.2
	89.0	-29	-21	878	196	.41	246	16.7	22.4	28.1	33.8	39.4
	84.0	-9	-4	700	153	.32	201	14.5	21.6	28.8	35.9	43.1
	(2) 84.0	-19	-13	724	164	.34	211	15.3	22.2	29.1	36.0	42.9
	84.0	-29	-23	750	173	.36	219	15.8	22.5	29.2	35.8	42.5
12000.	93.8	-9	0	969	204	.42	267	17.3	22.5	27.6	32.8	37.9
	(1) 95.2	-19	-9	1076	219	.45	281	16.8	21.5	26.1	30.8	35.4
	96.7	-29	-18	1207	236	.49	295	16.2	20.3	24.5	28.6	32.7
	88.0	-9	-2	803	181	.38	237	17.1	23.3	29.5	35.7	42.0
	88.0	-19	-11	829	188	.39	242	17.1	23.1	29.2	35.2	41.2
	88.0	-29	-21	854	195	.41	245	17.0	22.9	28.7	34.6	40.4
	82.0	-9	-4	653	149	.31	196	14.7	22.4	30.0	37.7	45.3
	(2) 82.0	-19	-14	675	159	.33	204	15.4	22.9	30.3	37.7	45.1
	82.0	-29	-23	699	168	.35	212	16.0	23.1	30.3	37.4	44.6

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23. Cruise (Sheet 4 of 10)

CRUISE
19,000 FEET

ANTI-ICE SYSTEMS OFF **ONE ENGINE**

								NAUTICAL MILES/100 LBS. FUEL				
WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	94.6	-13	-5	933	184	.40	250	16.0	21.4	26.8	32.1	37.5
	(1) 96.0	-23	-14	1039	204	.44	270	16.4	21.2	26.0	30.8	35.6
	97.4	-33	-22	1155	221	.48	286	16.1	20.4	24.8	29.1	33.4
	93.0	-13	-6	882	176	.38	238	15.6	21.3	27.0	32.6	38.3
	93.0	-23	-15	918	186	.40	247	16.1	21.5	27.0	32.4	37.9
	93.0	-33	-25	965	197	.43	256	16.1	21.3	26.5	31.7	36.9
	92.0	-13	-6	852	169	.37	229	15.1	21.0	26.8	32.7	38.6
	(2) 92.0	-23	-16	886	180	.39	239	15.7	21.3	27.0	32.6	38.3
	92.0	-33	-25	922	191	.41	248	16.0	21.5	26.9	32.3	37.7
15000.	94.6	-13	-4	933	190	.41	257	16.8	22.1	27.5	32.9	38.2
	(1) 95.9	-23	-13	1039	207	.45	274	16.8	21.6	26.4	31.2	36.0
	97.3	-33	-22	1155	223	.48	289	16.4	20.7	25.0	29.4	33.7
	92.0	-13	-6	852	176	.38	239	16.3	22.2	28.0	33.9	39.8
	92.0	-23	-15	887	186	.40	247	16.6	22.2	27.8	33.5	39.1
	92.0	-33	-25	926	195	.42	254	16.6	22.0	27.4	32.8	38.2
	90.0	-13	-7	796	163	.35	221	15.2	21.5	27.7	34.0	40.3
	(2) 90.0	-23	-16	825	174	.38	231	15.9	22.0	28.1	34.1	40.2
	90.0	-33	-25	860	185	.40	240	16.3	22.1	28.0	33.8	39.6
14000.	94.5	-13	-4	931	193	.42	261	17.3	22.7	28.0	33.4	38.8
	(1) 95.9	-23	-13	1042	210	.45	278	17.1	21.9	26.7	31.5	36.3
	97.3	-33	-22	1156	226	.49	292	16.6	20.9	25.3	29.6	33.9
	91.0	-13	-6	823	176	.38	239	16.9	23.0	29.0	35.1	41.2
	91.0	-23	-15	856	185	.40	246	17.1	22.9	28.7	34.6	40.4
	91.0	-33	-25	893	194	.42	252	17.0	22.6	28.2	33.8	39.4
	88.0	-13	-7	750	160	.35	217	15.5	22.2	28.9	35.5	42.2
	(2) 88.0	-23	-16	774	170	.37	226	16.2	22.7	29.1	35.6	42.1
	88.0	-33	-26	798	179	.39	232	16.6	22.9	29.1	35.4	41.6
13000.	94.5	-13	-4	933	197	.43	266	17.8	23.1	28.5	33.9	39.2
	(1) 95.9	-23	-13	1043	213	.46	282	17.4	22.2	27.0	31.8	36.6
	97.3	-33	-22	1159	228	.49	295	16.8	21.1	25.4	29.8	34.1
	90.0	-13	-6	800	177	.38	240	17.5	23.7	30.0	36.2	42.5
	90.0	-23	-15	824	185	.40	245	17.6	23.7	29.7	35.8	41.9
	90.0	-33	-25	862	193	.42	251	17.5	23.3	29.1	34.9	40.7
	86.0	-13	-7	704	156	.34	211	15.8	22.9	30.0	37.1	44.3
	(2) 86.0	-23	-17	727	165	.36	219	16.4	23.3	30.2	37.1	43.9
	86.0	-33	-26	751	174	.38	227	16.9	23.5	30.2	36.8	43.5
12000.	94.4	-13	-4	934	200	.43	270	18.2	23.5	28.9	34.2	39.6
	(1) 95.9	-23	-13	1045	215	.46	284	17.7	22.4	27.2	32.0	36.8
	97.3	-33	-22	1162	230	.50	298	17.0	21.3	25.6	29.9	34.2
	89.0	-13	-6	777	177	.38	240	18.0	24.4	30.9	37.3	43.7
	89.0	-23	-15	801	184	.40	245	18.1	24.3	30.6	36.8	43.1
	89.0	-33	-25	831	191	.41	249	17.9	23.9	29.9	36.0	42.0
	84.0	-13	-7	657	151	.33	205	16.0	23.6	31.2	38.9	46.5
	(2) 84.0	-23	-17	680	161	.35	213	16.7	24.0	31.4	38.7	46.1
	84.0	-33	-27	703	169	.37	221	17.1	24.3	31.4	38.5	45.6

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23. Cruise (Sheet 5 of 10)

CRUISE
21,000 FEET

ANTI-ICE SYSTEMS OFF **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	95.3	-17	-9	900	178	.40	249	16.5	22.1	27.6	33.2	38.7
	(1) 96.7	-27	-18	1004	198	.44	270	17.0	22.0	26.9	31.9	36.9
	98.1	-37	-26	1108	214	.48	287	16.8	21.4	25.9	30.4	34.9
	94.0	-17	-10	859	170	.38	238	16.0	21.8	27.7	33.5	39.3
	(2) 94.0	-27	-19	898	182	.41	249	16.6	22.2	27.8	33.3	38.9
	94.0	-37	-28	954	194	.44	260	16.8	22.0	27.2	32.5	37.7
15000.	95.2	-17	-8	895	183	.41	256	17.4	23.0	28.6	34.2	39.8
	(1) 96.6	-27	-17	1006	201	.45	276	17.5	22.4	27.4	32.4	37.3
	97.9	-37	-26	1107	217	.49	290	17.2	21.7	26.2	30.7	35.2
	93.0	-17	-9	830	171	.39	240	16.8	22.8	28.9	34.9	40.9
	93.0	-27	-19	861	181	.41	248	17.2	23.0	28.8	34.7	40.5
	93.0	-37	-28	915	192	.43	258	17.3	22.7	28.2	33.6	39.1
	92.0	-17	-10	800	164	.37	230	16.2	22.5	28.7	35.0	41.2
	(2) 92.0	-27	-19	833	175	.40	240	16.8	22.8	28.9	34.9	40.9
	92.0	-37	-29	874	186	.42	250	17.2	22.9	28.6	34.3	40.0
14000.	95.2	-17	-8	899	188	.42	262	18.1	23.6	29.2	34.7	40.3
	(1) 96.6	-27	-17	1008	205	.46	280	17.9	22.8	27.8	32.8	37.7
	98.0	-37	-26	1112	220	.49	294	17.4	21.9	26.4	30.9	35.4
	92.0	-17	-9	800	172	.39	241	17.6	23.8	30.1	36.3	42.5
	92.0	-27	-19	833	181	.41	249	17.8	23.8	29.8	35.8	41.8
	92.0	-37	-28	879	191	.43	256	17.8	23.5	29.2	34.9	40.5
	90.0	-17	-10	746	159	.36	223	16.5	23.2	29.9	36.6	43.3
	(2) 90.0	-27	-20	775	170	.38	233	17.2	23.6	30.1	36.5	42.9
	90.0	-37	-29	809	180	.41	242	17.5	23.7	29.9	36.1	42.3
13000.	95.1	-17	-8	898	191	.43	267	18.7	24.2	29.8	35.4	40.9
	(1) 96.5	-27	-17	1008	208	.47	284	18.2	23.2	28.1	33.1	38.1
	97.9	-37	-26	1113	222	.50	297	17.7	22.2	26.7	31.2	35.6
	91.0	-17	-9	772	172	.39	241	18.3	24.7	31.2	37.7	44.2
	91.0	-27	-19	805	181	.41	248	18.4	24.6	30.8	37.0	43.2
	91.0	-37	-29	843	189	.43	254	18.3	24.2	30.2	36.1	42.0
	88.0	-17	-11	702	156	.35	219	16.9	24.0	31.1	38.3	45.4
	(2) 88.0	-27	-20	723	165	.37	227	17.5	24.4	31.4	38.3	45.2
	88.0	-37	-30	753	175	.39	235	17.9	24.6	31.2	37.8	44.5
12000.	95.0	-17	-7	899	195	.44	272	19.1	24.7	30.2	35.8	41.3
	(1) 96.4	-27	-16	1010	210	.47	287	18.5	23.5	28.4	33.4	38.3
	97.9	-37	-25	1115	225	.50	300	17.9	22.4	26.9	31.4	35.8
	90.0	-17	-9	749	173	.39	242	18.9	25.6	32.3	38.9	45.6
	90.0	-27	-19	777	180	.41	247	18.9	25.4	31.8	38.3	44.7
	90.0	-37	-29	813	188	.42	253	18.8	24.9	31.1	37.2	43.4
	85.0	-17	-11	638	147	.33	206	16.6	24.4	32.3	40.1	47.9
	(2) 85.0	-27	-21	659	156	.35	215	17.5	25.0	32.6	40.2	47.8
	85.0	-37	-30	681	165	.37	223	18.0	25.3	32.7	40.0	47.3

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23 Cruise (Sheet 6 of 10)

CRUISE
23,000 FEET

ANTI-ICE SYSTEMS OFF **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	95.9	-21	-13	868	170	.40	246	16.8	22.5	28.3	34.0	39.8
	(1) 97.3	-31	-22	961	190	.44	268	17.5	22.7	27.9	33.1	38.3
	98.7	-41	-30	1057	206	.48	285	17.5	22.3	27.0	31.7	36.4
15000.	95.9	-21	-12	869	177	.42	256	17.9	23.7	29.4	35.2	40.9
	(1) 97.2	-31	-21	965	195	.46	276	18.2	23.4	28.6	33.7	38.9
	98.5	-41	-30	1057	209	.49	289	17.9	22.7	27.4	32.1	36.8
	94.0	-21	-14	806	165	.39	238	17.2	23.4	29.6	35.8	42.0
	(2) 94.0	-31	-23	847	176	.41	250	17.7	23.6	29.5	35.4	41.3
	94.0	-41	-32	896	188	.44	260	17.9	23.5	29.1	34.7	40.2
14000.	95.8	-21	-12	871	182	.43	263	18.7	24.5	30.2	36.0	41.7
	(1) 97.2	-31	-21	968	199	.47	281	18.7	23.9	29.0	34.2	39.4
	98.5	-41	-30	1060	213	.50	294	18.3	23.0	27.7	32.4	37.1
	93.0	-21	-13	779	167	.39	242	18.2	24.6	31.0	37.4	43.8
	93.0	-31	-23	816	177	.42	251	18.6	24.7	30.8	37.0	43.1
	93.0	-41	-32	864	187	.44	260	18.5	24.3	30.1	35.9	41.6
	92.0	-21	-14	753	160	.38	232	17.6	24.2	30.9	37.5	44.1
	(2) 92.0	-31	-23	783	171	.40	242	18.2	24.6	30.9	37.3	43.7
	92.0	-41	-33	826	182	.43	252	18.4	24.4	30.5	36.5	42.6
13000.	95.7	-21	-12	873	187	.44	270	19.5	25.2	30.9	36.6	42.4
	(1) 97.1	-31	-20	970	202	.47	286	19.1	24.3	29.4	34.6	39.7
	98.5	-41	-30	1061	215	.50	297	18.6	23.3	28.0	32.7	37.4
	92.0	-21	-13	754	168	.40	243	19.0	25.7	32.3	38.9	45.6
	92.0	-31	-23	783	177	.42	251	19.2	25.6	32.0	38.4	44.8
	92.0	-41	-32	831	186	.44	259	19.1	25.1	31.1	37.1	43.1
	90.0	-21	-14	698	155	.37	225	17.9	25.1	32.3	39.4	46.6
	(2) 90.0	-31	-24	729	166	.39	235	18.6	25.4	32.3	39.1	46.0
	90.0	-41	-33	762	176	.41	244	18.9	25.5	32.1	38.6	45.2
12000.	95.7	-21	-11	874	190	.45	275	20.0	25.7	31.4	37.2	42.9
	(1) 97.0	-31	-20	971	205	.48	289	19.5	24.6	29.8	34.9	40.1
	98.5	-41	-29	1066	218	.51	301	18.8	23.5	28.2	32.9	37.6
	91.0	-21	-13	728	169	.40	244	19.8	26.7	33.5	40.4	47.3
	91.0	-31	-23	757	177	.42	250	19.9	26.5	33.1	39.7	46.3
	91.0	-41	-32	798	185	.44	257	19.7	25.9	32.2	38.5	44.7
	87.0	-21	-15	635	147	.35	213	17.8	25.7	33.6	41.4	49.3
	(2) 87.0	-31	-24	658	157	.37	223	18.6	26.2	33.8	41.4	49.0
	87.0	-41	-34	683	166	.39	231	19.2	26.5	33.8	41.1	48.4

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23 Cruise (Sheet 7 of 10)

CRUISE
25,000 FEET

ANTI-ICE SYSTEMS OFF **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.	96.6	-25	-18	834	159	.39	238	16.5	22.5	28.5	34.5	40.5
	(1) 97.9	-35	-26	917	181	.44	265	18.0	23.5	28.9	34.4	39.8
	99.0	-45	-35	993	196	.48	280	18.2	23.2	28.2	33.3	38.3
15000.	96.5	-25	-17	832	168	.41	252	18.2	24.2	30.2	36.3	42.3
	(1) 97.9	-35	-25	924	188	.46	275	18.9	24.3	29.7	35.1	40.6
	99.0	-45	-34	998	201	.49	287	18.7	23.7	28.7	33.7	38.7
14000.	96.4	-25	-16	836	175	.43	262	19.4	25.4	31.3	37.3	43.3
	(1) 97.7	-35	-25	925	192	.47	281	19.5	25.0	30.4	35.8	41.2
	99.0	-45	-34	1005	205	.50	292	19.1	24.1	29.1	34.1	39.0
	95.0	-25	-17	789	167	.41	250	19.0	25.4	31.7	38.1	44.4
	95.0	-35	-26	837	179	.44	262	19.4	25.3	31.3	37.3	43.2
	95.0	-45	-35	881	189	.46	271	19.4	25.0	30.7	36.4	42.1
	94.0	-25	-17	760	161	.40	241	18.6	25.1	31.7	38.3	44.9
	(2) 94.0	-35	-27	800	172	.42	253	19.1	25.4	31.6	37.9	44.1
	94.0	-45	-36	847	184	.45	264	19.3	25.2	31.1	37.0	42.9
13000.	96.3	-25	-16	838	180	.44	270	20.3	26.2	32.2	38.2	44.1
	(1) 97.7	-35	-24	927	196	.48	286	20.1	25.5	30.9	36.2	41.6
	99.0	-45	-34	1007	208	.51	296	19.5	24.5	29.4	34.4	39.4
	94.0	-25	-17	758	168	.41	251	19.9	26.5	33.1	39.7	46.3
	94.0	-35	-26	805	178	.44	261	20.0	26.2	32.5	38.7	44.9
	94.0	-45	-35	852	188	.46	270	20.0	25.8	31.7	37.6	43.4
	92.0	-25	-18	705	156	.38	235	19.1	26.2	33.3	40.4	47.5
	(2) 92.0	-35	-27	737	167	.41	245	19.6	26.4	33.2	40.0	46.8
	92.0	-45	-36	781	177	.43	255	19.8	26.2	32.6	39.0	45.4
12000.	96.3	-25	-15	841	185	.45	276	20.9	26.9	32.8	38.8	44.7
	(1) 97.6	-35	-24	930	199	.49	291	20.5	25.9	31.3	36.6	42.0
	99.0	-45	-33	1011	211	.51	301	19.8	24.8	29.7	34.7	39.6
	92.0	-25	-17	706	164	.40	245	20.6	27.7	34.7	41.8	48.9
	92.0	-35	-27	741	173	.42	254	20.8	27.5	34.3	41.0	47.8
	92.0	-45	-36	789	183	.45	262	20.6	26.9	33.3	39.6	46.0
	89.0	-25	-19	632	147	.36	220	19.0	26.9	34.8	42.7	50.6
	(2) 89.0	-35	-28	660	157	.39	231	19.8	27.4	35.0	42.5	50.1
	89.0	-45	-37	690	167	.41	240	20.3	27.5	34.8	42.0	49.3

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23 Cruise (Sheet 8 of 10)

CRUISE
27,000 FEET

ANTI-ICE SYSTEMS OFF | **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
16000.												
	(1) 98.6	-38	-30	871	170	.43	258	18.1	23.8	29.6	35.3	41.1
	99.0	-48	-39	921	183	.47	271	18.5	24.0	29.4	34.8	40.3
15000.	97.1	-28	-21	796	157	.40	244	18.1	24.4	30.7	37.0	43.2
	(1) 98.5	-38	-29	876	178	.45	269	19.3	25.0	30.8	36.5	42.2
	99.0	-48	-39	930	189	.48	280	19.4	24.8	30.2	35.5	40.9
14000.	97.1	-28	-20	799	167	.43	259	19.9	26.1	32.4	38.7	44.9
	(1) 98.4	-38	-29	879	184	.47	278	20.3	26.0	31.7	37.3	43.0
	99.0	-48	-38	933	194	.49	287	20.0	25.4	30.8	36.1	41.5
	96.0	-28	-21	769	161	.41	250	19.5	26.0	32.5	39.0	45.5
	(2) 96.0	-38	-30	809	173	.44	263	20.1	26.3	32.5	38.6	44.8
	96.0	-48	-39	850	183	.47	271	20.1	26.0	31.9	37.7	43.6
13000.	96.9	-28	-20	800	173	.44	268	21.0	27.3	33.5	39.8	46.0
	(1) 98.3	-38	-28	882	188	.48	285	21.0	26.6	32.3	38.0	43.6
	99.0	-48	-38	941	198	.50	293	20.5	25.8	31.1	36.4	41.8
	95.0	-28	-21	742	163	.42	253	20.6	27.4	34.1	40.9	47.6
	95.0	-38	-30	784	174	.44	263	20.8	27.2	33.6	39.9	46.3
	95.0	-48	-39	827	184	.47	272	20.8	26.9	32.9	39.0	45.0
	93.0	-28	-22	687	150	.39	234	19.5	26.7	34.0	41.3	48.6
	(2) 93.0	-38	-31	723	163	.42	247	20.4	27.3	34.2	41.1	48.0
	93.0	-48	-40	766	174	.45	259	20.7	27.2	33.7	40.3	46.8
12000.	96.9	-28	-19	803	178	.46	276	21.9	28.1	34.4	40.6	46.8
	(1) 98.2	-38	-28	884	192	.49	290	21.5	27.2	32.8	38.5	44.1
	99.0	-48	-37	945	202	.51	298	20.9	26.2	31.5	36.8	42.1
	94.0	-28	-20	717	165	.42	256	21.7	28.7	35.7	42.7	49.7
	94.0	-38	-30	760	174	.45	265	21.7	28.3	34.8	41.4	48.0
	94.0	-48	-39	802	184	.47	272	21.5	27.7	34.0	40.2	46.5
	91.0	-28	-22	637	147	.38	229	20.2	28.1	36.0	43.8	51.7
	(2) 91.0	-38	-31	668	159	.41	241	21.1	28.6	36.1	43.5	51.0
	91.0	-48	-41	707	169	.43	251	21.3	28.4	35.4	42.5	49.6

CRUISE
29,000 FEET

ANTI-ICE SYSTEMS OFF | **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
15000.												
	(1) 99.0	-42	-34	822	165	.44	260	19.4	25.5	31.6	37.7	43.8
	99.0	-52	-43	859	176	.47	270	19.8	25.6	31.4	37.2	43.0
14000.	97.7	-32	-25	761	157	.42	252	20.0	26.6	33.2	39.7	46.3
	(1) 99.0	-42	-33	831	174	.46	274	20.9	26.9	32.9	38.9	44.9
	99.0	-52	-43	869	183	.49	280	20.8	26.5	32.3	38.0	43.8
13000.	97.5	-32	-24	764	165	.44	266	21.7	28.2	34.8	41.3	47.9
	(1) 98.9	-42	-33	836	180	.48	282	21.8	27.8	33.8	39.8	45.8
	99.0	-52	-42	874	188	.50	288	21.5	27.2	32.9	38.6	44.3
	96.0	-32	-25	722	158	.42	253	21.2	28.1	35.0	42.0	48.9
	96.0	-42	-34	760	168	.45	264	21.6	28.2	34.8	41.3	47.9
	96.0	-52	-43	795	177	.47	272	21.6	27.9	34.2	40.5	46.8
	95.0	-32	-25	693	150	.40	242	20.4	27.6	34.8	42.0	49.3
	(2) 95.0	-42	-34	731	163	.44	256	21.3	28.2	35.0	41.8	48.7
	95.0	-52	-44	769	173	.46	266	21.6	28.1	34.6	41.1	47.6
12000.	97.5	-32	-23	769	172	.46	276	22.8	29.3	35.9	42.4	48.9
	(1) 98.9	-42	-32	839	185	.49	289	22.5	28.5	34.4	40.4	46.4
	99.0	-52	-42	879	192	.51	293	22.0	27.7	33.4	39.1	44.8
	95.0	-32	-24	699	160	.43	257	22.5	29.7	36.8	44.0	51.2
	95.0	-42	-34	738	170	.45	267	22.6	29.4	36.1	42.9	49.7
	95.0	-52	-43	774	179	.48	274	22.5	28.9	35.4	41.8	48.3
	93.0	-32	-25	645	148	.40	238	21.4	29.2	36.9	44.7	52.5
	(2) 93.0	-42	-35	680	159	.43	251	22.1	29.5	36.8	44.2	51.6
	93.0	-52	-44	721	170	.45	261	22.4	29.3	36.3	43.2	50.2
11000.	97.4	-32	-23	772	176	.47	283	23.7	30.2	36.6	43.1	49.6
	(1) 98.8	-42	-32	841	188	.50	294	23.1	29.0	35.0	40.9	46.9
	99.0	-52	-41	881	195	.52	299	22.5	28.2	33.9	39.6	45.2
	93.0	-32	-25	646	156	.42	251	23.4	31.1	38.9	46.6	54.3
	93.0	-42	-34	686	166	.44	261	23.4	30.7	38.0	45.3	52.6
	93.0	-52	-43	725	175	.47	269	23.3	30.2	37.1	44.0	50.9
	90.0	-32	-26	575	139	.37	224	21.5	30.2	38.9	47.6	56.3
	(2) 90.0	-42	-36	601	150	.40	236	22.6	30.9	39.2	47.5	55.8
	90.0	-52	-45	642	161	.43	248	23.0	30.8	38.6	46.4	54.2

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23 Cruise (Sheet 9 of 10)

CRUISE
31,000 FEET

ANTI-ICE SYSTEMS OFF | **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
14000.												
	(1) 99.0	-46	-38	766	159	.44	259	20.7	27.3	33.8	40.3	46.9
	99.0	-56	-47	800	169	.47	269	21.1	27.4	33.6	39.9	46.1
13000.	98.3	-36	-28	724	155	.43	259	21.9	28.8	35.8	42.7	49.6
	(1) 99.0	-46	-37	774	168	.47	274	22.4	28.9	35.4	41.8	48.3
	99.0	-56	-47	808	176	.49	280	22.3	28.5	34.7	40.9	47.1
12000.	98.2	-36	-27	730	164	.46	273	23.6	30.5	37.3	44.2	51.0
	(1) 99.0	-46	-36	781	175	.49	284	23.5	29.9	36.3	42.7	49.1
	99.0	-56	-46	813	181	.50	288	23.1	29.2	35.4	41.5	47.7
	96.0	-36	-28	676	154	.43	256	23.1	30.5	37.9	45.3	52.7
	96.0	-46	-38	710	164	.46	266	23.4	30.4	37.5	44.5	51.6
	96.0	-56	-47	743	172	.48	273	23.4	30.1	36.8	43.6	50.3
	95.0	-36	-29	650	148	.41	246	22.5	30.2	37.9	45.5	53.2
	(2) 95.0	-46	-38	686	159	.44	259	23.2	30.5	37.8	45.1	52.3
	95.0	-56	-48	719	168	.47	268	23.3	30.3	37.2	44.2	51.1
11000.	98.1	-36	-27	733	169	.47	281	24.8	31.6	38.4	45.2	52.1
	(1) 99.0	-46	-36	788	180	.50	291	24.3	30.6	37.0	43.3	49.7
	99.0	-56	-46	818	186	.52	294	23.7	29.8	36.0	42.1	48.2
	95.0	-36	-28	658	157	.44	262	24.6	32.2	39.8	47.4	55.0
	95.0	-46	-37	692	166	.46	270	24.6	31.8	39.0	46.3	53.5
	95.0	-56	-47	724	174	.48	276	24.3	31.2	38.1	45.0	51.9
	92.0	-36	-30	581	139	.39	232	22.8	31.4	40.0	48.6	57.2
	(2) 92.0	-46	-39	613	151	.42	246	23.9	32.0	40.2	48.3	56.5
	92.0	-56	-48	651	162	.45	258	24.2	31.9	39.6	47.3	55.0

CRUISE
33,000 FEET

ANTI-ICE SYSTEMS OFF | **ONE ENGINE**

WT. LBS.	FAN PERCENT RPM	TEMP DEG. C	RAT DEG. C	FUEL FLOW LBS/HR	KIAS	IND. MACH	KTAS	NAUTICAL MILES/100 LBS. FUEL 100 KT. HEADWIND	50 KT. HEADWIND	ZERO WIND	50 KT. TAILWIND	100 KT. TAILWIND
13000.	99.0	-40	-33	676	139	.41	240	20.7	28.1	35.5	42.9	50.3
	(1) 99.0	-50	-42	710	153	.45	258	22.3	29.3	36.4	43.4	50.4
	99.0	-60	-51	741	163	.47	268	22.7	29.4	36.2	42.9	49.7
12000.	98.8	-40	-32	687	154	.45	265	24.1	31.3	38.6	45.9	53.2
	(1) 99.0	-50	-41	721	163	.47	275	24.2	31.2	38.1	45.1	52.0
	99.0	-60	-51	749	170	.50	280	24.0	30.7	37.4	44.1	50.7
	97.0	-40	-33	644	144	.42	249	23.1	30.9	38.6	46.4	54.2
	(2) 97.0	-50	-42	677	155	.45	262	23.9	31.3	38.7	46.1	53.5
	97.0	-60	-51	708	164	.48	270	24.0	31.1	38.2	45.2	52.3
11000.	98.7	-40	-31	693	161	.47	278	25.8	33.0	40.2	47.4	54.6
	(1) 99.0	-50	-40	729	169	.49	285	25.4	32.3	39.1	46.0	52.9
	99.0	-60	-50	756	176	.51	289	24.9	31.6	38.2	44.8	51.4
	96.0	-40	-32	632	151	.44	261	25.4	33.4	41.3	49.2	57.1
	96.0	-50	-41	663	159	.46	269	25.4	33.0	40.5	48.1	55.6
	96.0	-60	-51	693	167	.49	275	25.3	32.5	39.7	46.9	54.1
	94.0	-40	-33	583	139	.41	240	24.0	32.6	41.2	49.7	58.3
	(2) 94.0	-50	-42	618	151	.44	255	25.1	33.1	41.2	49.3	57.4
	94.0	-60	-52	649	160	.47	264	25.3	33.0	40.7	48.4	56.1

(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Figure 7-23 Cruise (Sheet 10 of 10)

DESCENT

Performance for two types of descent is presented on the following pages. Time, distance and fuel information are provided for a normal descent of 800 pounds per hour total fuel flow and 2000 feet per minute, and a high speed descent of 600 pounds per hour total fuel and 3000 feet per minute.

This performance is based on controlling the fan speed to obtain the fuel flows, airspeed and rates of descent presented with gear and flaps up, speedbrakes retracted and anti-ice systems OFF or ON.

The time, distance and fuel used from a given altitude is based on descending to sea level. If the descent is to another altitude, the difference in time, distance and fuel used between the initial and the final altitude must be determined.

Begin descent at M_{MO} -10 KIAS, reduce power to desired fuel flow. Maintain desired rate of descent when obtained.

The data is based on a gross weight of 11,000 pounds and standard day temperature. However, weight and temperature effects are minimal and the data can be used for all conditions.

NORMAL DESCENT - 2000 FEET PER MINUTE

ANTI-ICE SYSTEMS - OFF SPEEDBRAKES RETRACTED, GEAR AND FLAPS UP

800 POUNDS PER HOUR (400 POUNDS PER HOUR PER ENGINE)

PRESSURE ALTITUDE FT	TIME MIN	FUEL USED LBS	DISTANCE - NAUTICAL MILES						
			100 KT HEADWIND	50 KT HEADWIND	25 KT HEADWIND	ZERO WIND	25 KT TAILWIND	50 KT TAILWIND	100 KT TAILWIND
45,000	22.5	293	94	113	122	132	141	150	169
43,000	21.5	281	89	107	116	125	134	143	160
41,000	20.5	270	84	101	109	118	126	135	152
39,000	19.5	258	79	95	103	111	119	127	143
37,000	18.5	246	73	89	96	104	112	119	135
35,000	17.5	233	68	83	90	97	104	112	126
33,000	16.5	220	63	77	83	90	97	104	118
31,000	15.5	207	58	71	77	83	90	96	109
29,000	14.5	193	53	65	71	77	83	89	101
27,000	13.5	180	48	59	65	70	76	81	93
25,000	12.5	167	43	53	59	64	69	74	85
23,000	11.5	153	39	48	53	58	62	67	77
21,000	10.5	140	34	43	47	52	56	60	69
19,000	9.5	127	30	38	42	46	50	54	62
17,000	8.5	113	26	33	37	40	44	47	54
15,000	7.5	100	22	29	32	35	38	41	47
10,000	5.0	67	14	18	20	22	24	26	30
5000	2.5	33	6	8	9	10	12	13	15
0	0.0	0	0	0	0	0	0	0	0

WHEN THE ANTI-ICE SYSTEMS ARE ON, DECREASE THE DISTANCE 7%.
TIME AND FUEL USED REMAIN THE SAME.

Figure 7-24. Normal Descent - 2000 Feet Per Minute

HIGH SPEED DESCENT - 3000 FEET PER MINUTE
ANTI-ICE SYSTEMS - OFF SPEEDBRAKES RETRACTED, GEAR AND FLAPS UP
600 POUNDS PER HOUR (300 POUNDS PER HOUR PER ENGINE)

PRESSURE ALTITUDE FT	TIME MIN	FUEL USED LBS	DISTANCE - NAUTICAL MILES						
			100 KT HEADWIND	50 KT HEADWIND	25 KT HEADWIND	ZERO WIND	25 KT TAILWIND	50 KT TAILWIND	100 KT TAILWIND
45,000	15.0	146	63	76	82	88	94	101	113
43,000	14.3	141	60	72	78	84	90	95	107
41,000	13.7	135	56	68	73	79	85	90	102
39,000	13.0	129	53	64	69	74	80	85	96
37,000	12.3	123	49	60	65	70	75	80	90
35,000	11.7	117	46	56	60	65	70	75	85
33,000	11.0	110	42	52	56	61	65	70	79
31,000	10.3	103	39	48	52	56	61	65	73
29,000	9.7	97	36	44	48	52	56	60	68
27,000	9.0	90	33	40	44	48	51	55	63
25,000	8.3	83	30	36	40	43	44	50	57
23,000	7.7	77	27	33	36	39	43	46	52
21,000	7.0	70	24	30	32	35	38	41	47
19,000	6.3	63	21	26	29	31	34	37	42
17,000	5.7	57	18	23	25	28	30	32	37
15,000	5.0	50	16	20	22	24	26	28	32
10,000	3.3	33	10	13	14	15	17	18	21
5,000	1.7	17	5	6	7	7	8	9	10
0	0.0	0	0	0	0	0	0	0	0

WHEN THE ANTI-ICE SYSTEMS ARE ON, DECREASE THE DISTANCE 5%.
TIME AND FUEL USED REMAIN THE SAME.

Figure 7-25. High Speed Descent - 3000 Feet Per Minute

HOLDING

Holding fuel in total pounds per hour is presented for various weights at several altitudes.

These data are based on a nominal holding speed with gear and flaps up and speed brakes retracted.

HOLDING FUEL
ANTI-ICE SYSTEMS OFF

SPEEDBRAKES RETRACTED **GEAR AND FLAPS UP**

WEIGHT POUNDS	KIAS	TOTAL POUNDS PER HOUR — PRESSURE ALTITUDE - FEET						
		SEA LEVEL	5000	10,000	15,000	20,000	25,000	30,000
16,000	195	1269	1195	1133	1078	1037	1009	996
15,000	190	1217	1145	1081	1028	988	956	939
14,000	185	1166	1095	1032	979	939	906	885
13,000	180	1117	1046	984	930	891	857	832
12,000	175	1068	998	937	883	844	809	782
11,000	170	1019	950	891	837	798	764	735

WHEN THE ANTI-ICE SYSTEMS ARE ON, INCREASE THE FUEL FLOW BY 8 PERCENT.
A MINIMUM OF 60% N_2 IS REQUIRED TO OPEN THE ENGINE ANTI-ICE VALVES.

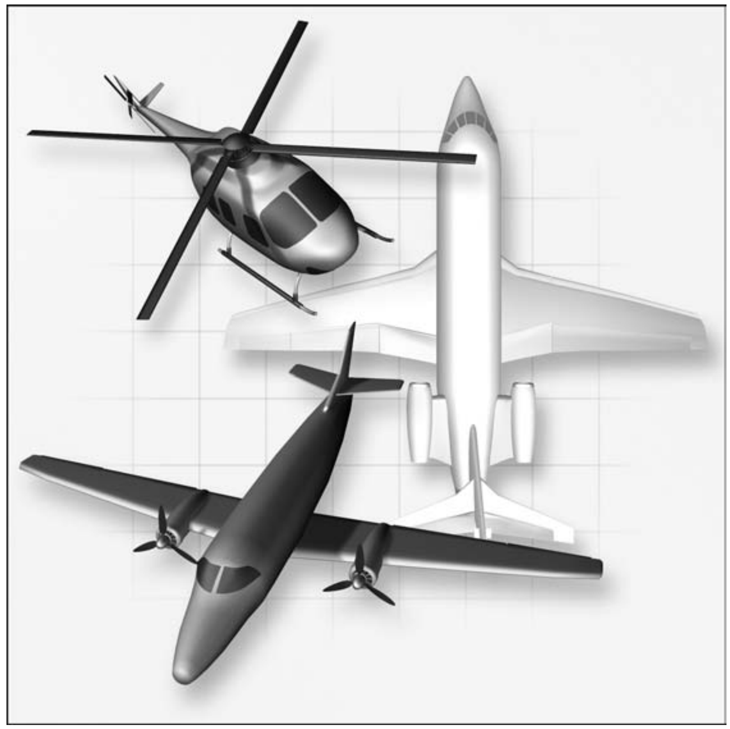
Figure 7-26. Holding Fuel

CHAPTER 21
CREW RESOURCE MANAGEMENT

CONTENTS

ILLUSTRATIONS

CHAPTER 21
CREW RESOURCE MANAGEMENT (CRM)



INTRODUCTION

This chapter describes crew resource management program. Information is provided on the crew concept briefing guide and altitude callouts between pilots.

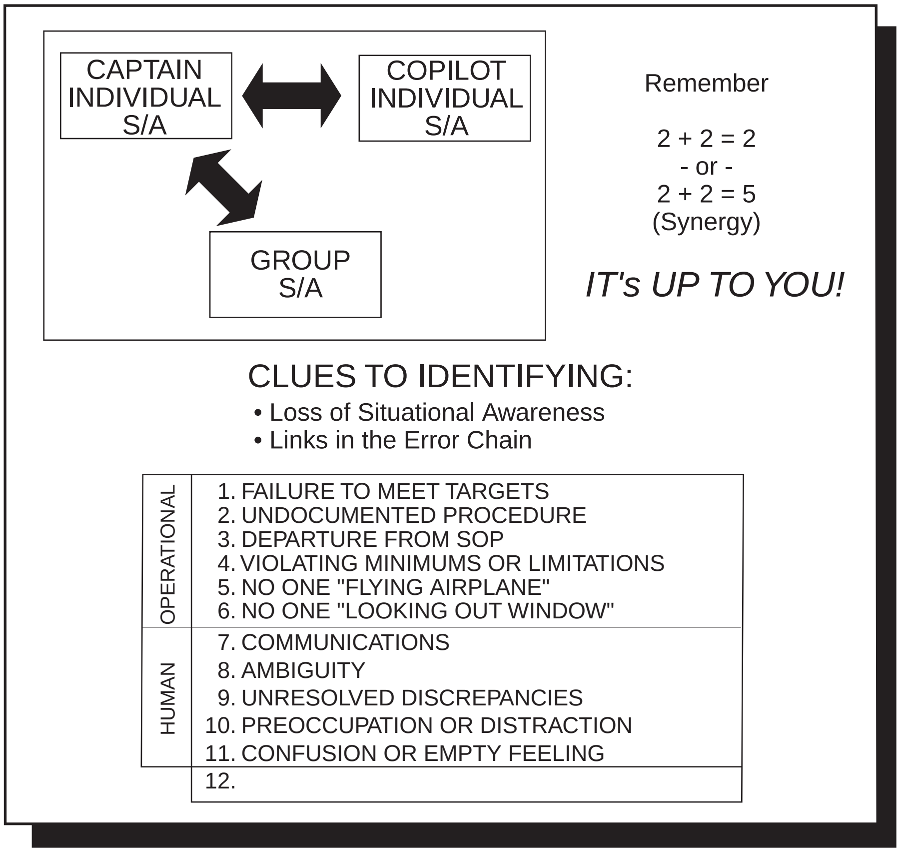


Figure 21-1. Situational Awareness in the Cockpit

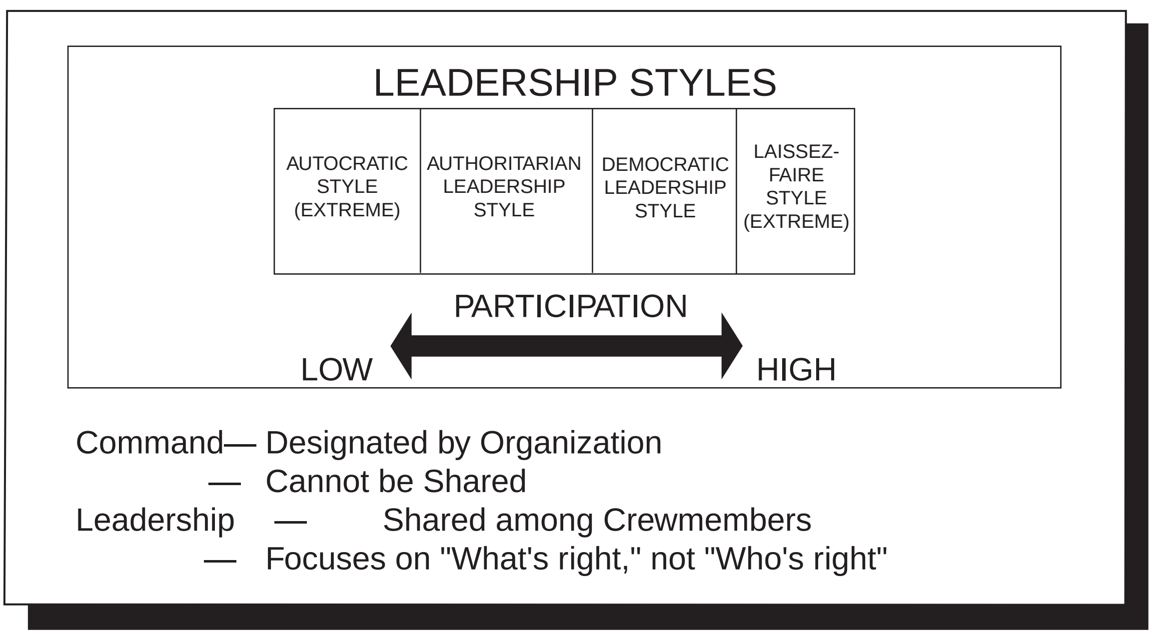


Figure 21-2. Command and Leadership

CREW CONCEPT BRIEFING GUIDE

DESCRIPTION

Experience has shown that adherence to SOP's helps to enhance individual and crew cockpit situational awareness and will allow a higher performance level to be attained. Our objective is for standards to be agreed upon prior to flight and then adhered to, such that maximum crew performance is achieved. These procedures are not intended to supersede any individual company SOP, but rather are examples of good operating practices.

COMMON TERMS

PIC Pilot in Command

Designated by the company for flights requiring more than one pilot. Responsible for conduct and safety of the flight. Designates pilot flying and pilot not flying duties.

PF Pilot Flying

Controls the airplane with respect to assigned runway, course, altitude, airspeed, etc., during normal and emergency conditions. Accomplishes other tasks as directed by the PIC.

PNF Pilot Not Flying

Maintains ATC communications, copies clearances, accomplishes checklists and other tasks as directed by the PIC.

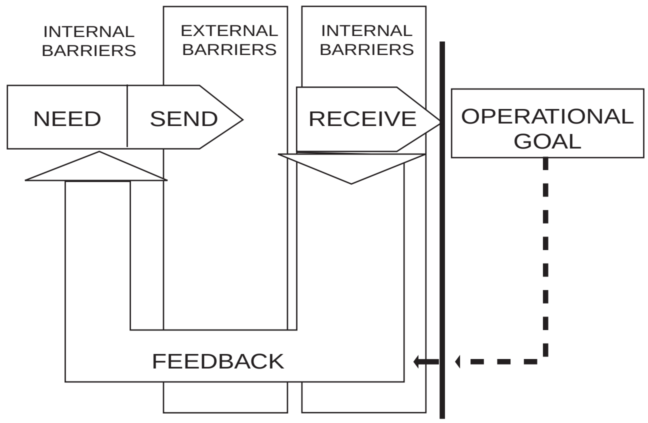
B Both

PRETAKEOFF BRIEFING (IFR/VFR)

NOTE

The following briefing is to be completed during item 1 of the Pretakeoff checklist. The PF will accomplish the briefing.

1. Review the departure procedure (route and altitude, type of takeoff, significant terrain features, etc.)
2. Review anything out of the ordinary.
3. Review required callouts, unless standard calls have been agreed upon, in which case a request for "Standard Callouts" may be used.
4. Review the procedures to be used in case of an emergency.
5. As a final item, ask if there are any questions.
6. State that the pretakeoff briefing is complete.



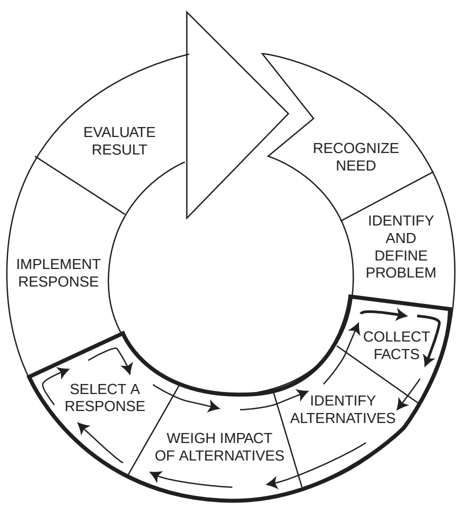
THINK:
- Solicit and give feedback
- Listen carefully
- Focus on behavior, not people
- Maintain focus on the goal
- Verify operation outcome is achieved

ADVOCACY: to increase others' S/A
- State Position
- Suggest Solutions
- Be Persistent and Focused
- Listen Carefully

INQUIRY: to increase your own S/A
- Decide What, Whom, How to ask
- Ask Clear, Concise Questions
- Draw Conclusions from Valid Information
- Keep an Open Mind

— REMEMBER—
Questions enhance communication flow.
Don't give in to the temptation to ask questions when Advocacy is required.
Use of Advocacy or inquiry should raise a "red flag."

Figure 21-3. Communication Process



HINTS:
- Identify the problem:
  - Communicate it
  - Achieve agreement
  - Obtain commitment
- Consider appropriate SOP's
- Think beyond the obvious alternatives
- Make decisions as a result of the process
- Resist the temptation to make an immediate decision and then support it with facts

Figure 21-4. Decision-Making Process

CREW COORDINATION APPROACH SEQUENCE

NOTE

The following crew coordination approach sequence should be completed as early as possible, prior to initiating an IFR approach. The items are accomplished during the "APPROACH (IN RANGE)" checklist.

PF—Requests the PNF to obtain destination weather. (Transfer of communication duties to the PF may facilitate the accomplishment of this task.

PNF—Advises the PF of current destination weather, approach in use, and special information pertinent to the destination.

PF—Requests the PNF to perform the approach setup.

PNF—Accomplishes the approach setup and advises of frequency tuned, identified and course set.

PF—Transfers control of the airplane to the PNF, advising, "You have control, heading _____, altitude ____" and special instructions. (Communications duties should be transferred back to the PNF at this point.)

PNF—Responds, "I have control heading _____, altitude ____"

PF—Advises, "Approach Briefing"

PF—At the completion of the approach briefing, the PF advises, "Approach Briefing Complete."

PF—Advises, "I have control heading ____, altitude ____"

PNF—Confirms, "You have control heading ____, altitude ____"

PF—"Before Landing Checklist."

PNF—"Before Landing Checklist Complete."

NOTE

The above sequence should be completed prior to the FAF.

During the above sequence, the terms PF and PNF have not been reversed during the time that transfer of control occurs.

SITUATIONAL AWARENESS

a. Accomplishes appropriate preflight planning.

b. Sets and monitors targets.

c. Stays ahead of the aircraft by preparing for expected or contingency situations.

d. Monitors weather, aircraft systems, instruments, and ATC communications.

e. Shares relevant information with the rest of the crew.

f. Uses advocacy/inquiry to maintain/regain situational awareness.

g. Recognizes error chain clues and takes actions to break links in the chain.

h. Communicates objectives and gains agreement when appropriate.

i. Uses effective listening techniques to maintain/regain situational awareness.

STRESS

a. Recognizes symptoms of stress in self and others.

b. Maintains composure, calmness, and rational decision making under stress.

c. Adaptable to stressful situations/personalities.

d. Uses stress management techniques to reduce effects of stress.

e. Maintains open, clear lines of communications when under stress.

COMMUNICATION

a. Establishes open environment for interactive communication.

b. Conducts adequate briefings to convey required information.

c. Recognizes and works to overcome barriers to communications.

d. Operational decisions are clearly stated to other crewmembers and acknowledged.

e. Crewmembers are encouraged to state their own ideas, opinions, and recommendations.

f. Crewmembers are encouraged to ask questions regarding crew actions.

g. Assignments of blame is avoided. Focuses on **WHAT** is right, and not **WHO** is right.

h. Keeps feedback loop active until operational goal/decision is achieved.

i. Conducts debriefings to correct substandard/inappropriate performance and to reinforce desired performance.

Figure 21-5. Crew Performance Standards (Sheet 1 of 2)

SYNERGY AND CREW CONCEPT

a. Ensures that group climate is appropriate to operational situation.
b. Coordinates flight crew activities to achieve optimum performance.
c. Uses effective team building techniques.
d. Demonstrates effective leadership and motivation techniques.
e. Uses all available resources.
f. Adapt leadership style to meet operational and human requirements.

WORKLOAD MANAGEMENT

a. Communicates crew duties and receives acknowledgement.
b. Sets priorities for crew activities.
c. Recognizes and reports overloads in self and in others.
d. Eliminates distractions in high workload situations.
e. Maintains receptive attitude during high workload situations.
f. Uses other crewmember.
g. Avoids being a "one man show."

DECISION MAKING

a. Anticipates problems in advance.
b. Uses SOPs in decision making process.
c. Seeks information from all available resources when appropriate.
d. Avoids biasing source of information.
e. Considers and weighs impact of alternatives.
f. Selects appropriate courses of action in a timely manner.
g. Evaluates outcome and adjusts/reprioritizes.
h. Recognizes stress factors when making decisions and adjusts accordingly.
i. Avoids making a decision and then going in search of facts that support it.

ADVANCED/AUTOMATED COCKPITS

a. Follows automation related SOPs.
b. Specifies pilot and copilot duties and responsibilities with regard to automation.
c. Verbalizes and acknowledges entries and changes in flight operation.
d. Verifies status and programming of automation.
e. Selects appropriate levels of automation.
f. Programs automation well in advance of maneuvers.
g. Recognizes automation failure/invalid output indications.

Figure 21-5. Crew Performance Standards (Sheet 2 of 2)

ALTITUDE CALLOUTS

ENROUTE

1,000 Feet Prior to Level Off

CHALLENGE	RESPONSE
PNF-State altitude leaving and assigned level off altitude	**PF-**“ROGER”
PNF-“200 above/below”	**PF-**“LEVELING”

APPROACH—PRECISION

CHALLENGE	RESPONSE
At 1,000 ft above minimums	
PNF-“1,000 feet above minimums”	**PF-**“DH ______”
At 500 ft above minimums	
PNF-“500 above minimums”	**PF-**“CROSS-CHECK, NO FLAGS”
At 100 ft above minimums	
PNF-“100 feet above minimums, outside”	
At decision height	
PF-“Minimums”	**PNF-** “Lights, at ______, CONTINUE”
At 100 ft AGL	
PNF-“Runway in sight”	**PF-**“VISUAL, LANDING”
PNF-“Speed & Rate”	
OR	
PNF-“Minimums, not in sight”	**PF-**“GO AROUND”

APPROACH—NONPRECISION

CHALLENGE	RESPONSE
At 1,000 ft above minimums	
PNF-“1,000 feet above minimums”	**PF-**“MDA ______”
At 500 ft above minimums	
PNF-“500 above minimums”	**PF-**“CROSS CHECK, NO FLAGS”
At 100 ft above minimums	
PNF-“100 feet above minimums, outside”	
At minimum descent altitude (MDA)	
PF-“Minimums”	**PNF-**“CONTINUE”
At missed approach point (MAP)	
PF-“Missed Approach Point”	**PNF-**“Lights, at ______, CONTINUE”
PF-“VISUAL, LANDING”	**PNF-**“Speed & Rate”
OR	
PF-“Missed Approach Point”	**PNF-**“Runway not in sight”
PF-“GO AROUND”	

SIGNIFICANT DEVIATION CALLOUT

CHALLENGE	RESPONSE
IAS ±10 KIAS	
PNF-“VREF ± ______”	**PF-**“CORRECTING TO ______”
Heading ±10°, 5° on approach	
PNF-“Heading ______ degrees left/right”	**PF-**“CORRECTING TO ______”
Altitude +/- 100 ft enroute, ±50 ft on final approach	
PNF-“Altitude ______ high/low”	**PF-**“CORRECTING TO ______”
CDI left or right one dot	
PNF-“Left/right of course ______ dot”	**PF-**“CORRECTING”

RMI course left or right ±5°

PNF-“Left/right of course ______ degrees” **PF-**“CORRECTING”

Vertical descent speed greater than 1,000 fpm on final approach

PNF-“Sink rate ______” **PF-**“CORRECTING”

Bank in Excess of 30°

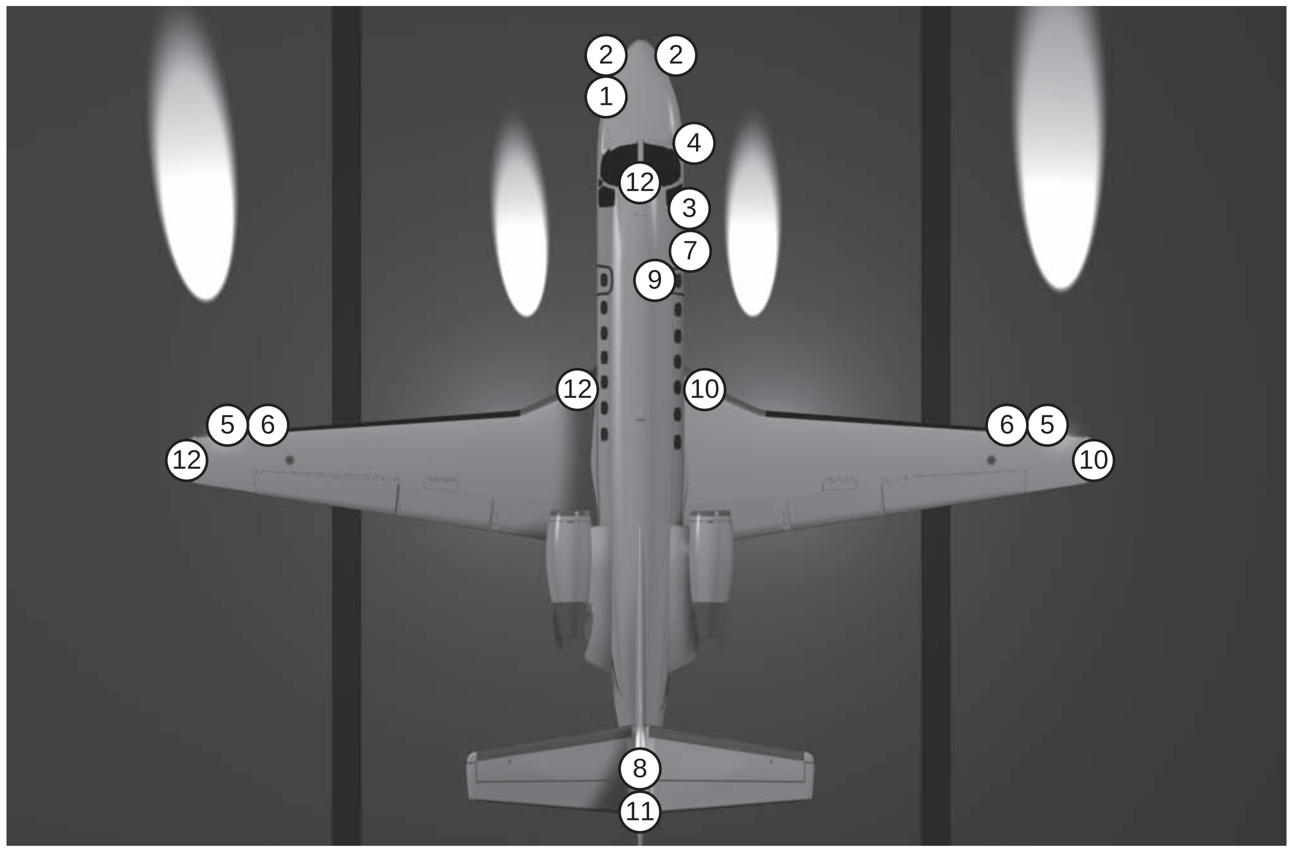
PNF-“Bank ______ degrees” **PF-**“CORRECTING”

WALKAROUND

The following section is a pictorial walkaround. Each item listed in the exterior power-off preflight inspection is displayed.

The foldout pages contain photographs that depict the specific area to be inspected. The general photographs contain circled numbers that correspond to specific steps displayed on the subsequent pages.

HOT ITEMS AND LIGHTS



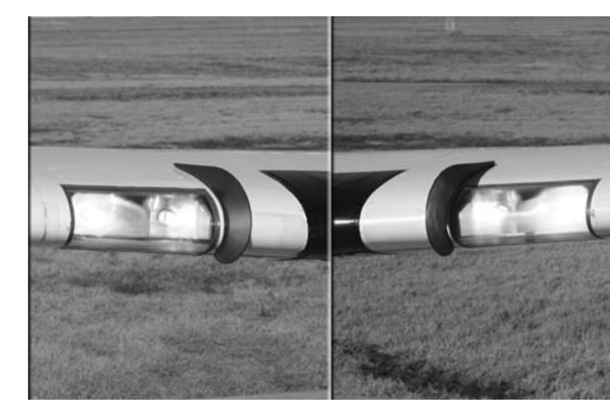
1. **LEFT AND RIGHT STATIC PORTS**—CLEAR AND WARM

2. **LEFT AND RIGHT PITOT TUBES**—CLEAR AND HOT

3. **STANDBY AIRSPEED PITOT TUBE**—CLEAR AND HOT

4. **RAM AIR TEMPERATURE PROBE**—CLEAR

5. **LANDING LIGHTS**—BOTH ON



6. **RECOGNITION LIGHTS**—BOTH ON

7. **ANGLE-OF-ATTACK VANE**—FREE AND HOT

8. **FLASHING BEACON**—ON AND FLASHING

9. **EMERGENCY EXIT LIGHT**—ON

10. **RIGHT WING INSPECTION, NAVIGATION, AND STROBE LIGHTS**—ON

11. **TAIL NAVIGATION LIGHT**—ON

12. **LEFT WING INSPECTION, NAVIGATION, AND STOBE LIGHTS**—ON

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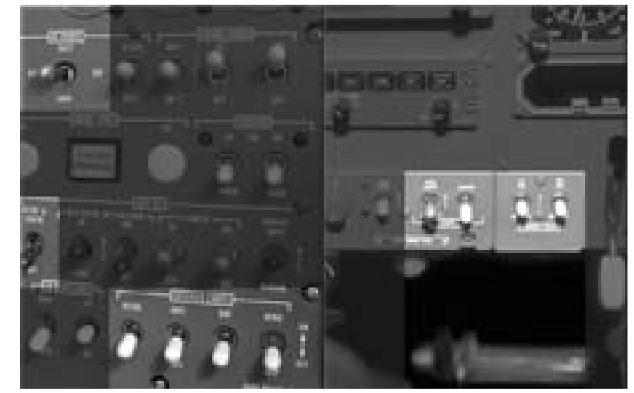

13. **LIGHTS AND BATTERY SWITCHES**—OFF

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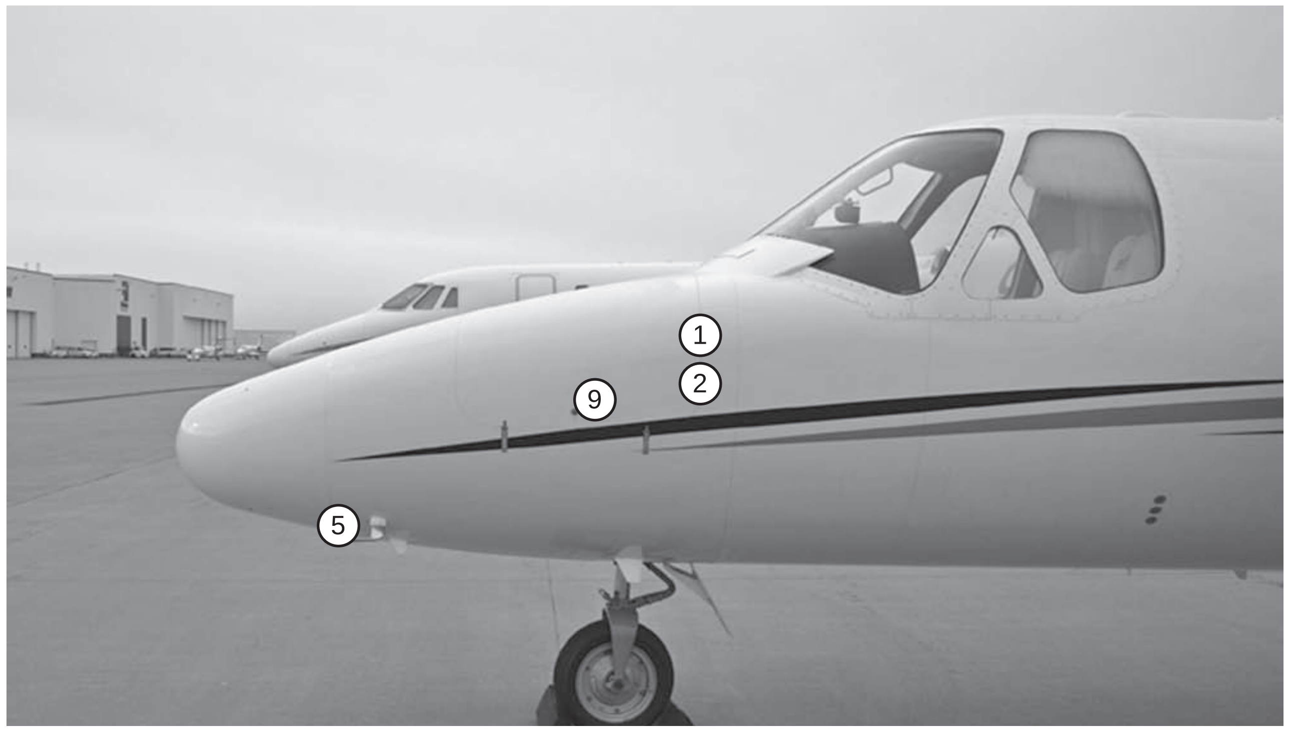
LEFT NOSE



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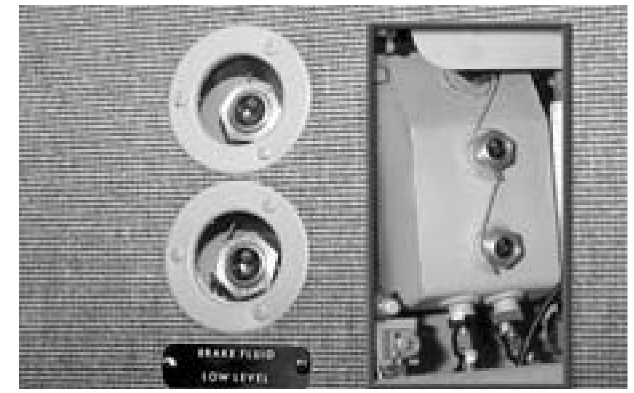
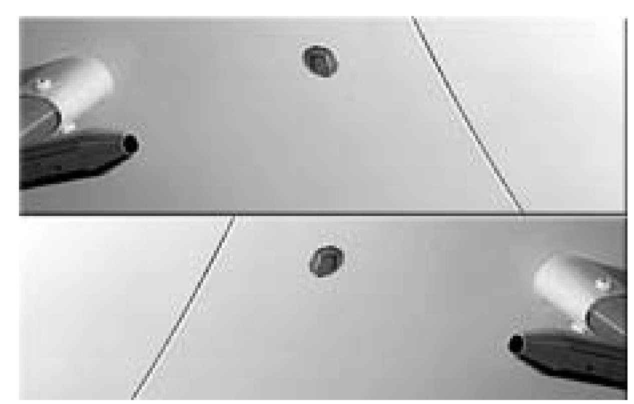


1. **BRAKE FLUID RESERVOIR SIGHT GAUGES**—FLUID VISIBLE

2. **POWER BRAKE ACCUMULATOR CHARGE**—LIGHT GREEN ARC

3. **BAGGAGE DOOR**—SECURE AND LOCKED

4. **NOSE GEAR, DOORS, WHEEL AND TIRE**—CONDITION AND SECURE



5. **AVIONICS BAY LATCHES**—SECURE

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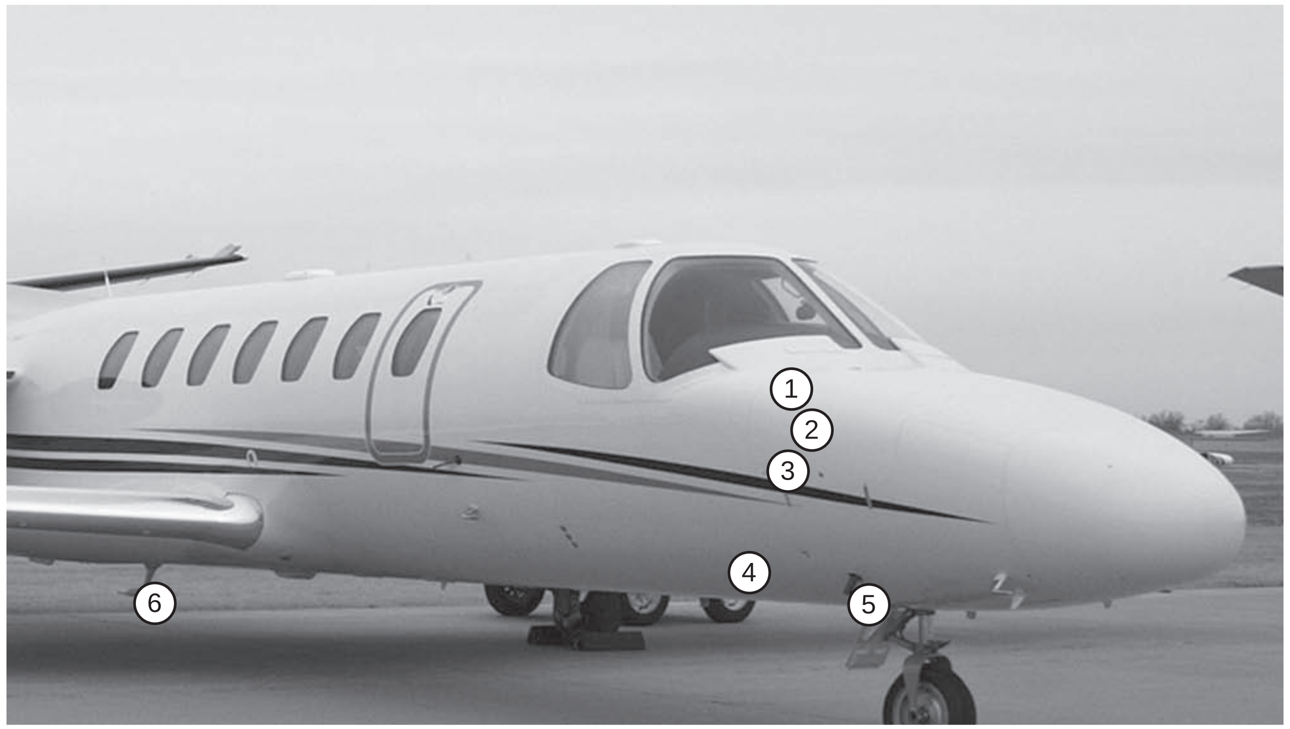
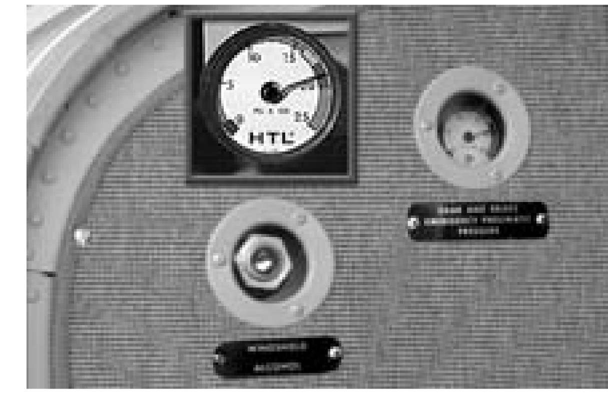
RIGHT NOSE AND FUSELAGE RIGHT SIDE



1. **WINDSHIELD ALCOHOL RESERVOIR SIGHT GAUGE**—FLUID VISIBLE



2. **BRAKE AND GEAR PNEUMATIC PRESSURE GAUGE**—GREEN ARC

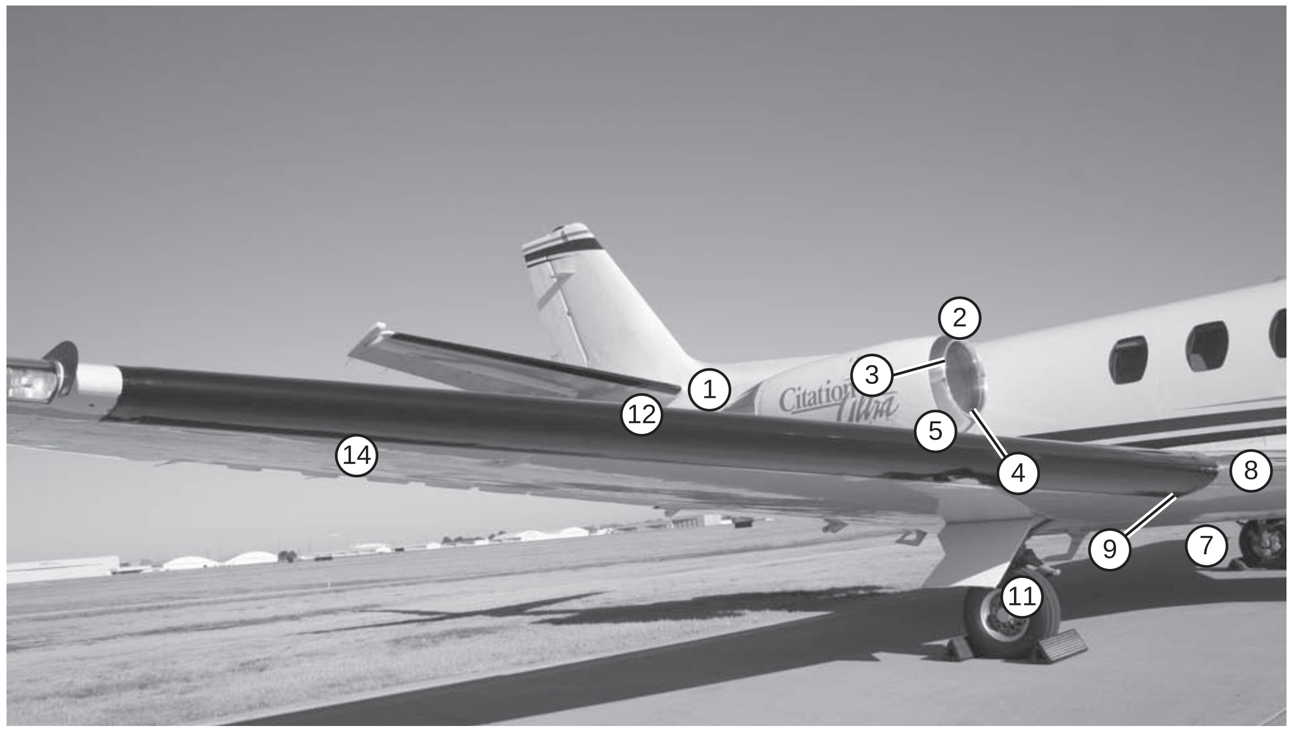
3. **BAGGAGE DOOR**—SECURE AND LOCKED

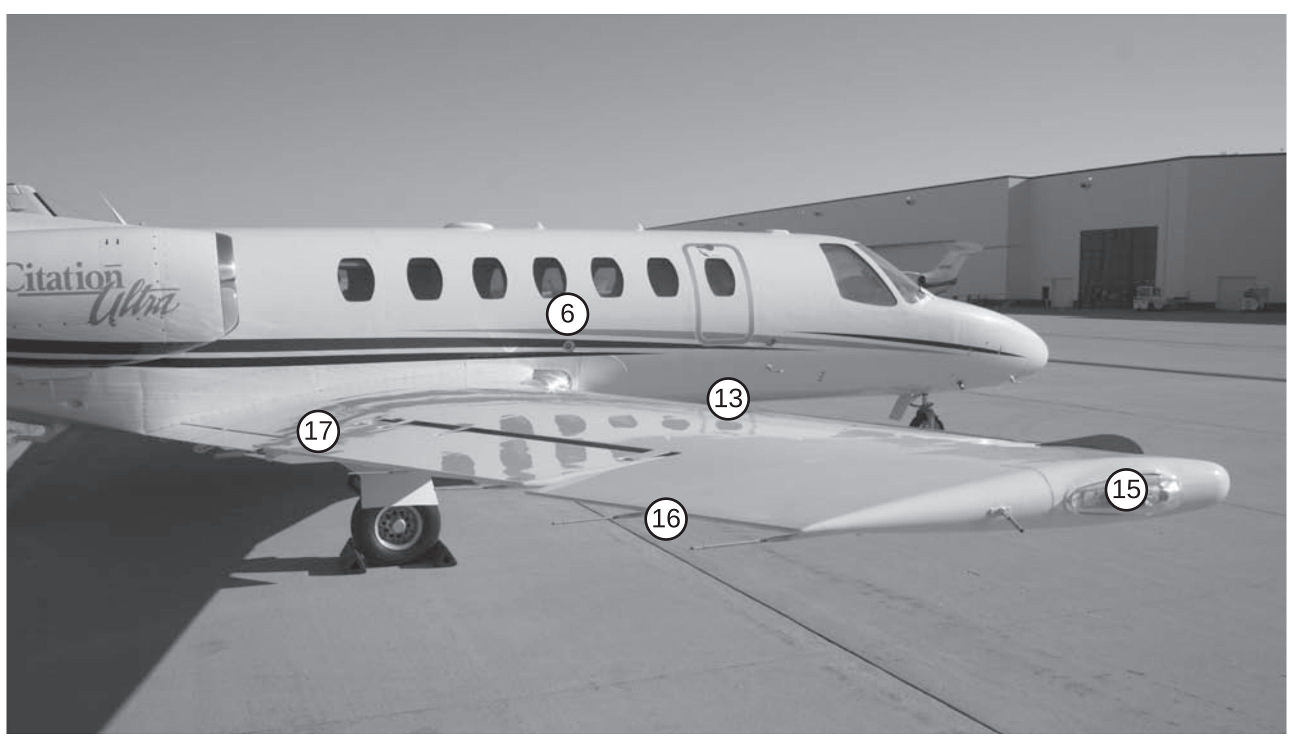
4. **OXYGEN BLOWOUT DISC**—GREEN

5. **OVERBOARD VENT LINES**—CLEAR

6. **TOP AND BOTTOM ANTENNAS**—CONDITION AND CLEAR

RIGHT WING





1. **DORSAL FIN AIR INLET**—CLEAR

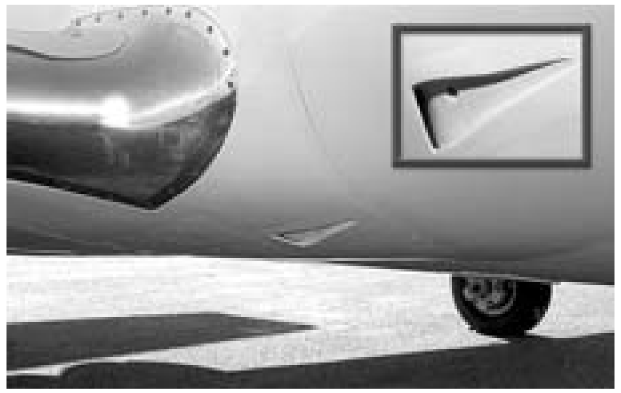
2. **PYLON TAILCONE AIR INLET**—CLEAR

3. **FORWARD T_1 SENSOR**—CONDITION

4. **ENGINE FAN DUCT AND FAN**—CONDITION

5. **GENERATOR COOLING AIR INLET**—CLEAR

6. **WING INSPECTION LIGHT**—CONDITION



7. **ANTI-ICE BLEED AIR COOLING AIR INLET**—CLEAR

8. **HEATED LEADING EDGE**—CONDITION AND VENTS CLEAR

9. **FUEL QUICK DRAIN**—DRAIN AND CHECK FOR CONTAMINATION (6)

10. **FUEL FILTER DRAIN**—DRAIN

11. **MAIN GEAR, DOOR, WHEEL, TIRE, BRAKE**—CONDITION AND SECURE

12. **DEICE BOOT**—CONDITION AND SECURE

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13. **FUEL FILLER CAP**—SECURE

14. **FUEL TANK VENT**—CLEAR

15. **NAVIGATION, STROBE, LANDING AND RECOGNITION LIGHTS**—CONDITION

16. **STATIC WICKS**—CHECK (5)

17. **AILERON, FLAPS, AND SPEED BRAKES**—CONDITION AND SECURE

RIGHT NACELLE

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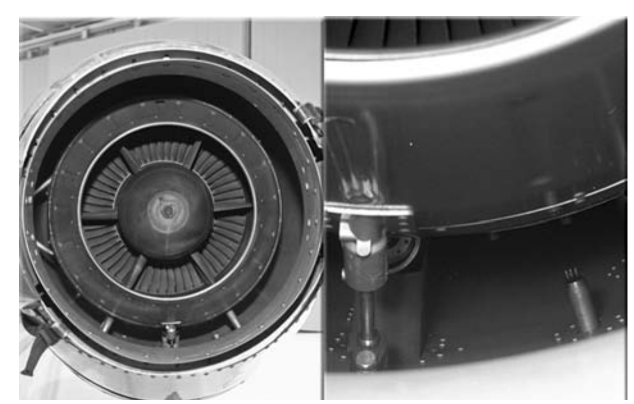
1. **OIL LEVEL—**CHECK;
FILLER CAP AND ACCESS DOOR—SECURE

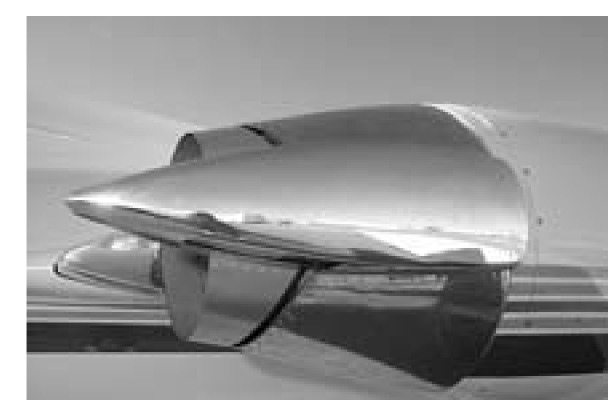
2. **GENERATOR COOLING AIR EXHAUST**—CLEAR

3. **ENGINE FLUID DRAIN MAST**—CLEAR

4. **ENGINE EXHAUST AND BYPASS DUCTS**—CONDITION AND CLEAR



5. **AFT T_1 SENSOR**—CONDITION



6. **THRUST REVERSER BUCKETS**—CONDITION AND STOWED

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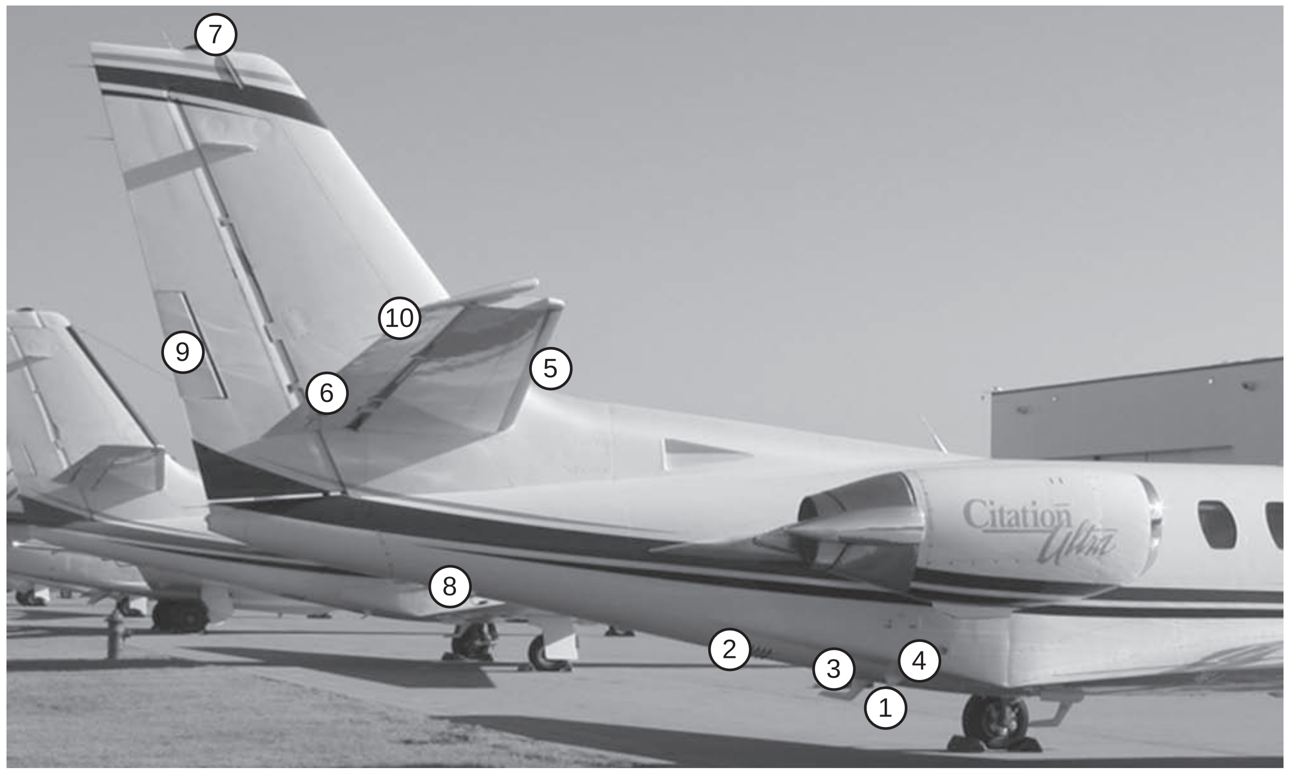
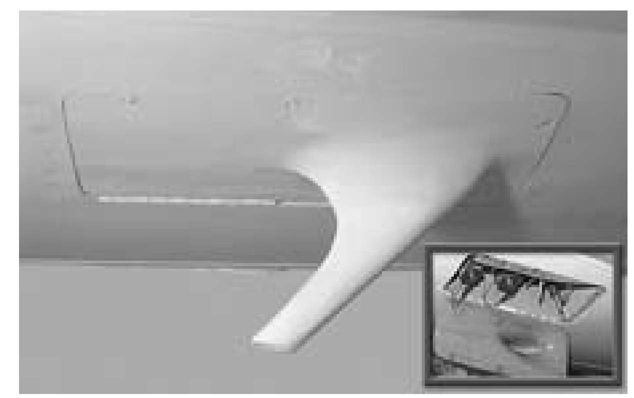
RIGHT EMPENNAGE



1. **DEICE BOOT OVERBOARD VENTS**—CLEAR

2. **AIR CONDITIONING OVERBOARD EXHAUST**—CLEAR



3. **HYDRAULIC SERVICE DOOR**—SECURE, DRAIN MAST CLEAR

4. **ANTI-ICE BLEED AIR COOLING AIR EXHAUST**—CLEAR

5. **RIGHT HORIZONTAL STABILIZER DEICE BOOT**—CONDITION AND SECURE

6. **RIGHT ELEVATOR AND TRIM TAB**—MOVEMENT AND CONDITION

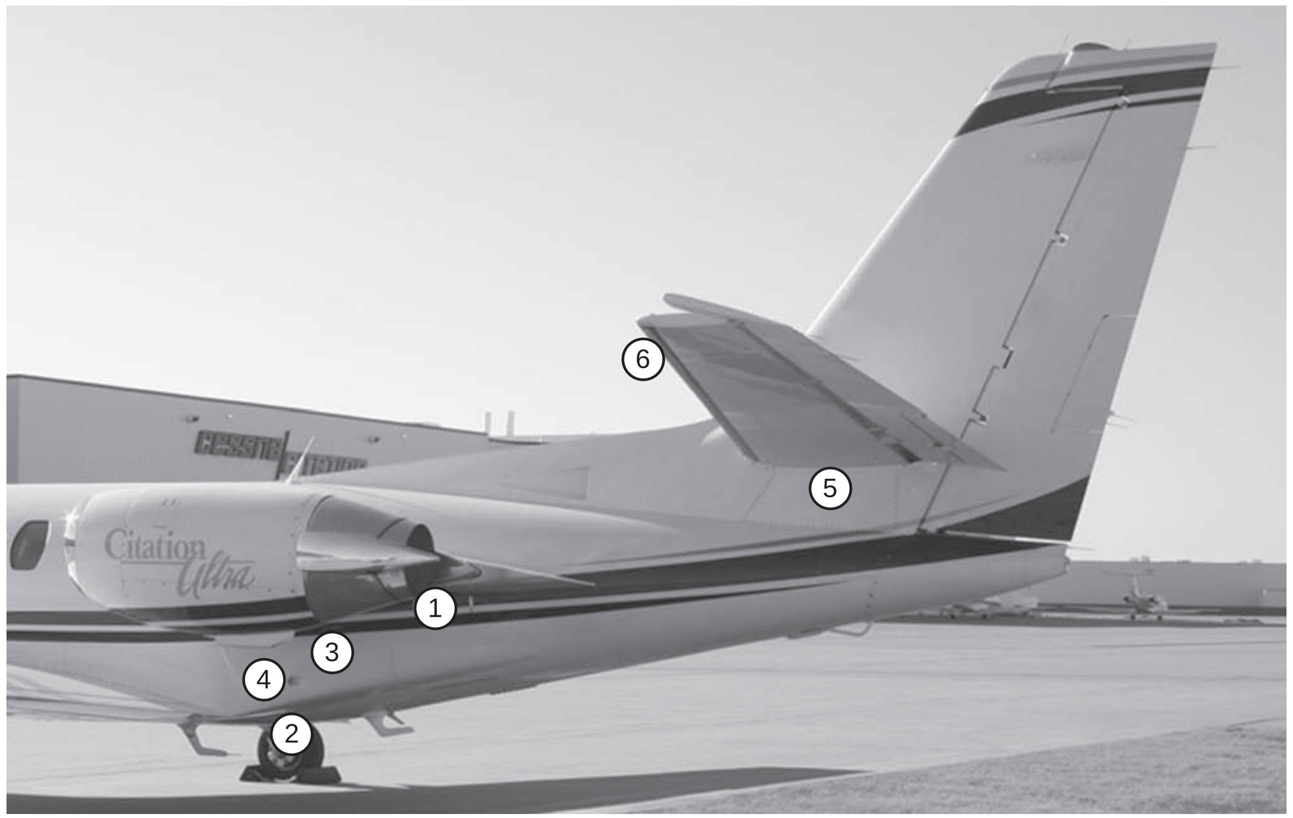
7. TAIL MOUNTED ROTATING BEACON LIGHT— CONDITION

8. TAIL SKID—CONDITION AND SECURE

9. RUDDER AND TRIM TAB—SECURE AND CORRECT SERVO TAB ACTION

10. STATIC WICKS (RUDDER, VERTICAL STABILIZER AND BOTH ELEVATORS)—CHECK (8)

LEFT EMPENNAGE



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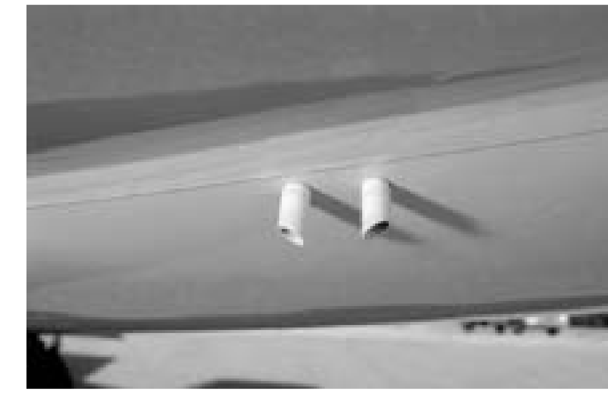
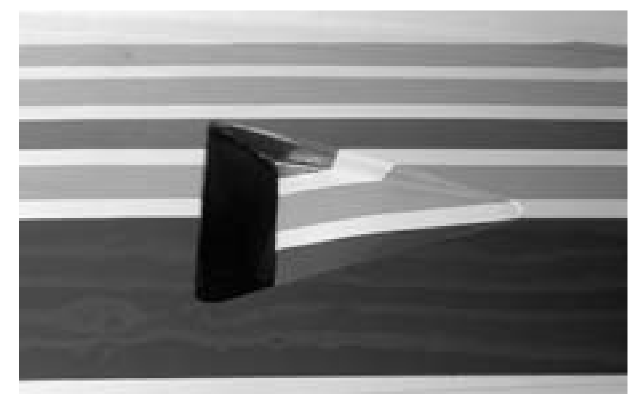
1. **EXTERNAL POWER SERVICE DOOR**—SECURE

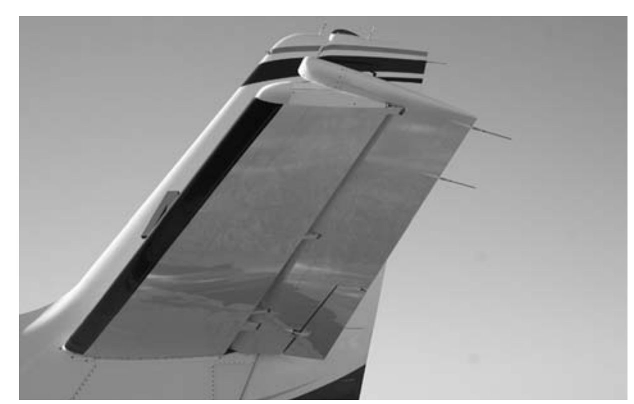


2. **BATTERY COOLING INTAKE AND VENT LINES**—CLEAR

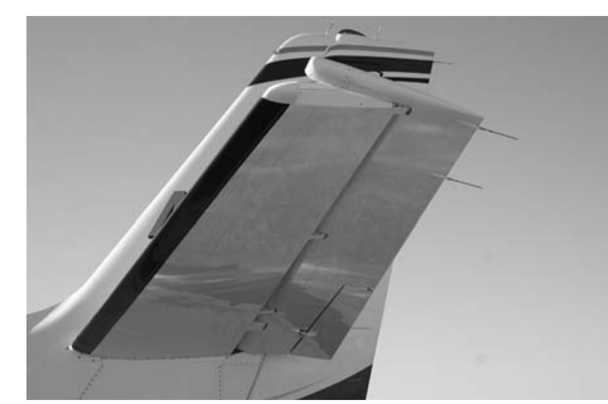


3. **WINDSHIELD HEAT EXCHANGER OVERBOARD EXHAUST**—CLEAR

4. **ANTI-ICE BLEED AIR COOLING AIR EXHAUST**—CLEAR

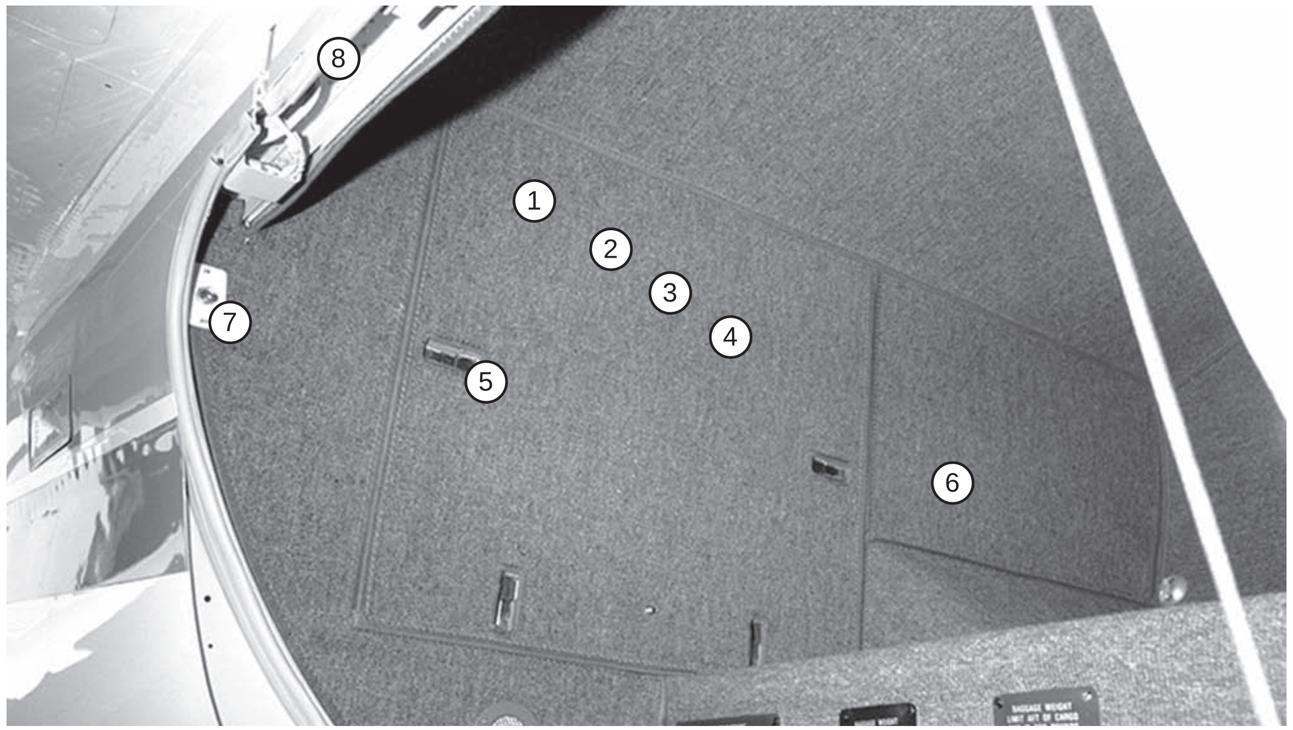


5. **LEFT ELEVATOR AND TRIM TAB**—MOVEMENT AND CONDITION



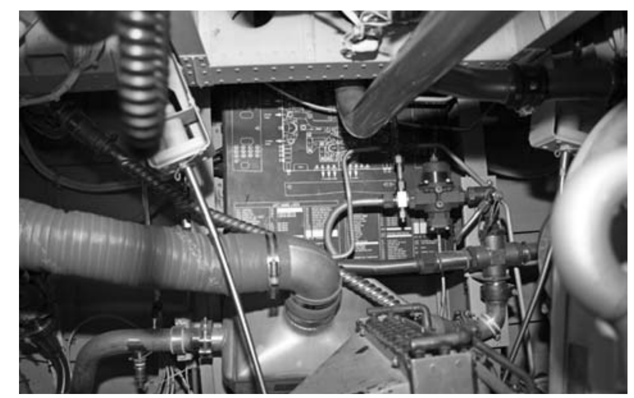
6. **LEFT HORIZONTAL STABILIZER DEICE BOOT**—CONDITION AND SECURE

AFT COMPARTMENT



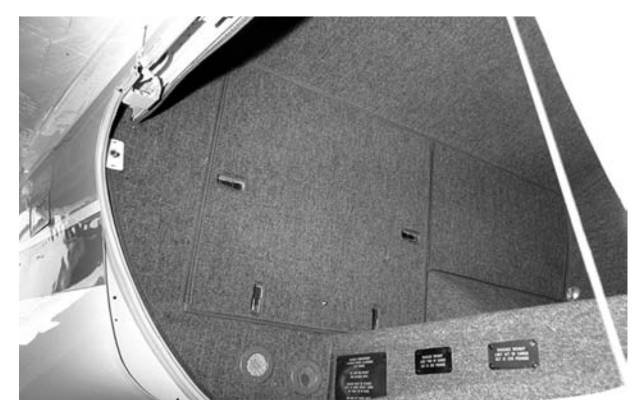
1. **HYDRAULIC FLUID QUANTITY**—CHECK

2. **FIRE BOTTLE PRESSURE GAUGES**—CHECK TEMPERATURE PRESSURE RELATIONSHIP

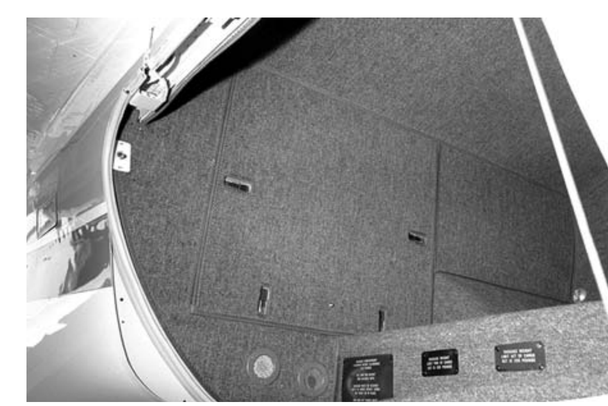


3. **J-BOX CIRCUIT BREAKERS**—IN

4. **ACM OIL LEVEL**—CHECK



5. **TAILCONE ACCESS DOOR**—SECURE

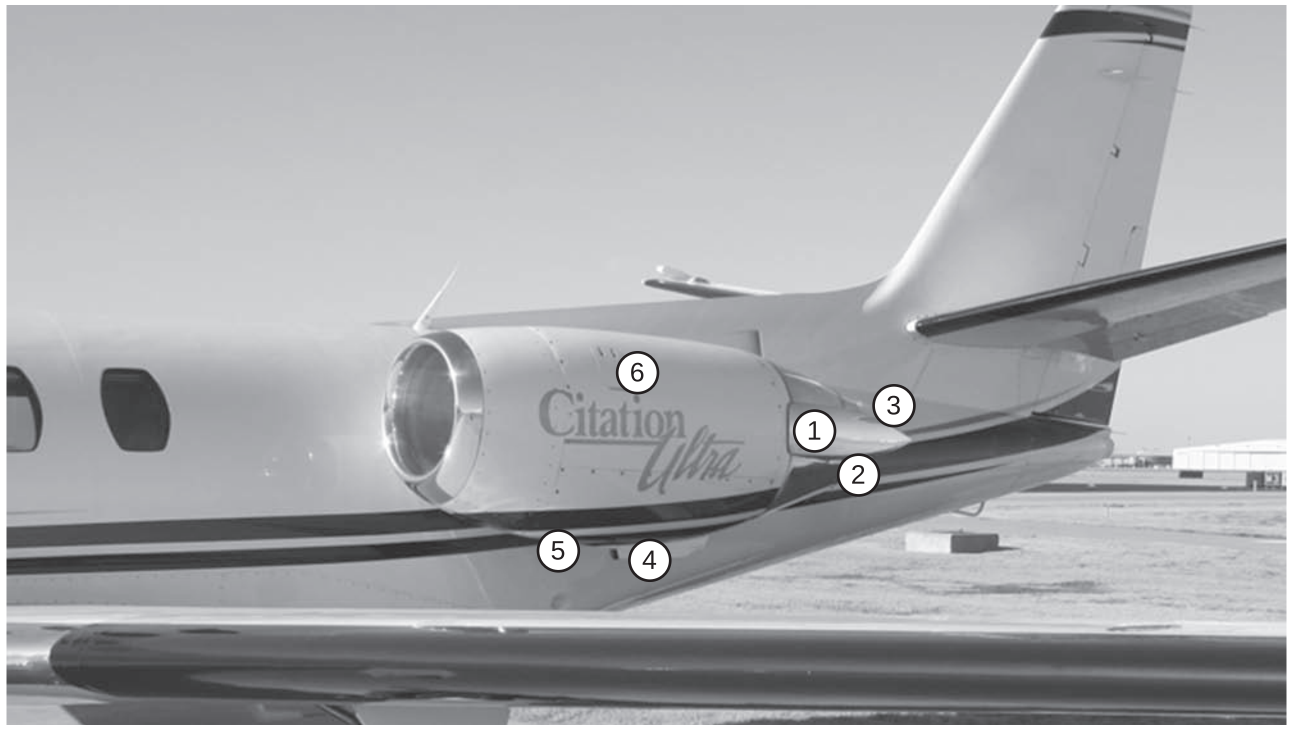


6. **AFT COMPARTMENT BAGGAGE SECURED, ENGINE COVERS SECURED**

7. **AFT COMPARTMENT LIGHT**—OFF

8. **AFT COMPARTMENT ACCESS DOOR**—SECURE AND LOCKED

LEFT NACELLE



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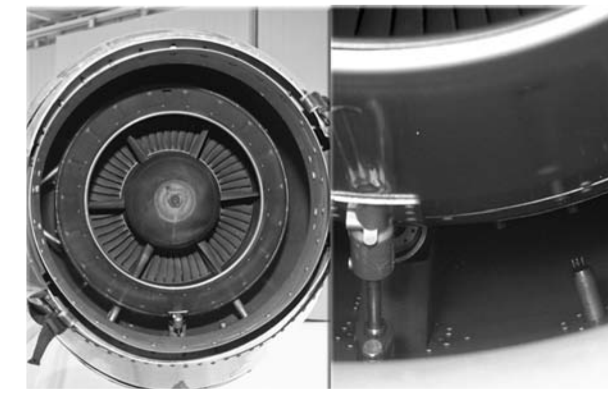
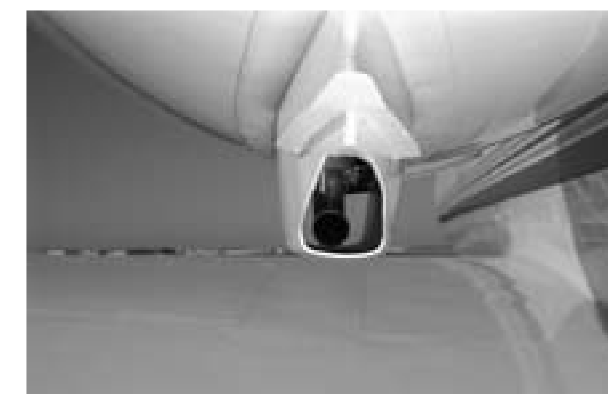
1. **THRUST REVERSER BUCKETS**—CONDITION AND STOWED



2. **AFT T_1 SENSOR**—CONDITION

3. **ENGINE EXHAUST AND BYPASS DUCTS**—CONDITION AND CLEAR



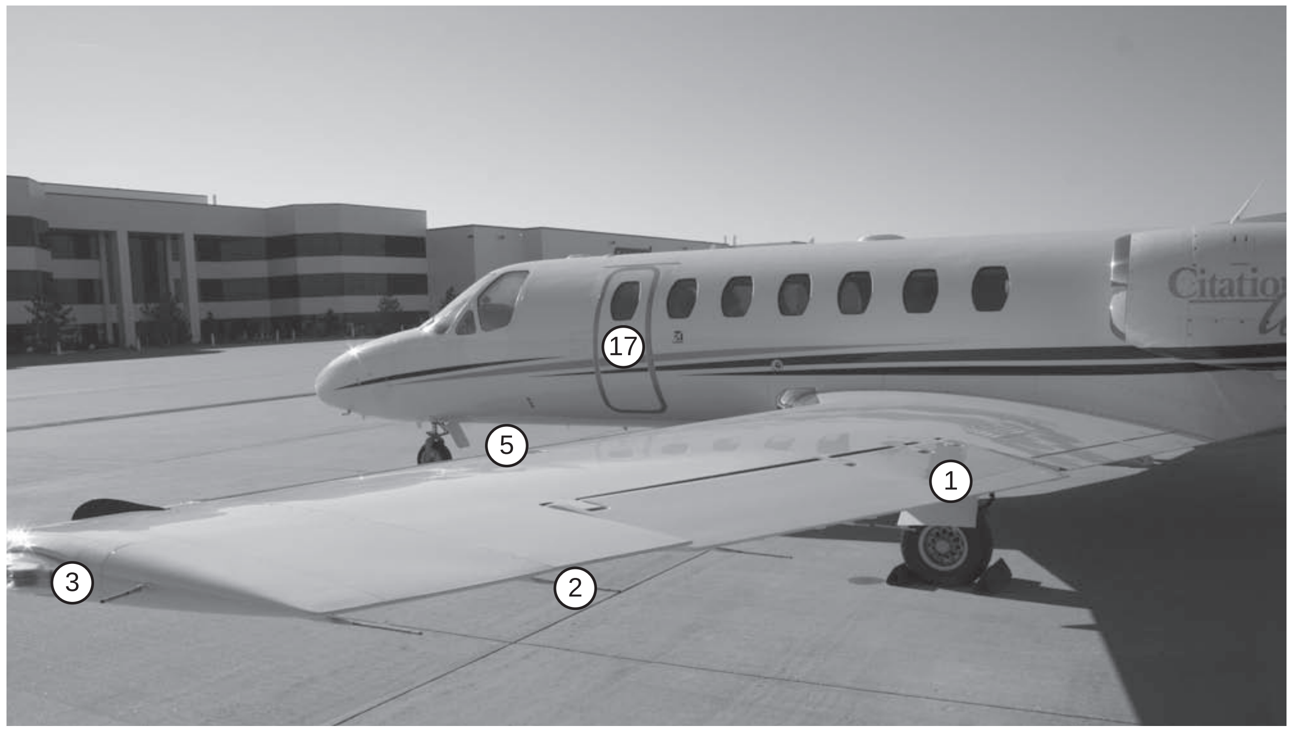
4. **ENGINE FLUID DRAIN MAST**—CLEAR

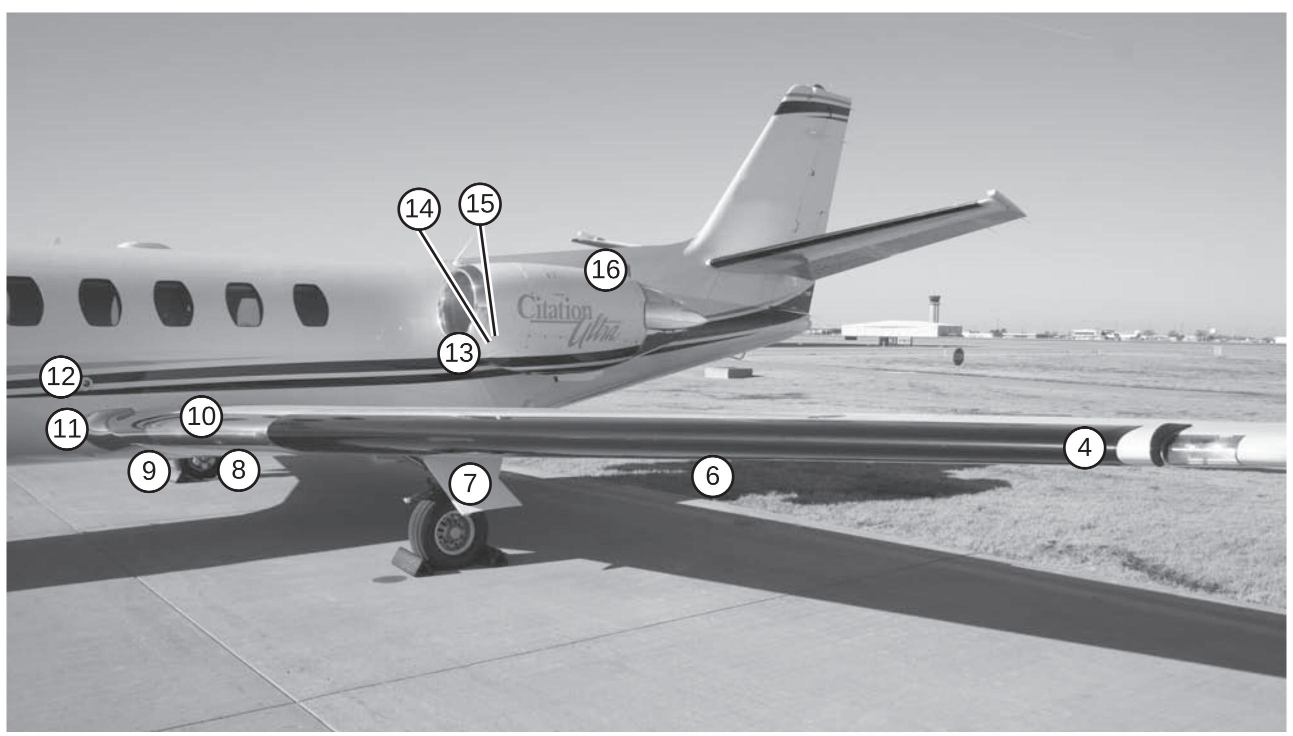
5. **GENERATOR COOLING AIR EXHAUST**—CLEAR

6. **OIL LEVEL—**CHECK;
FILLER CAP AND ACCESS DOOR—SECURE

FOR TRAINING PURPOSES ONLY

LEFT WING





FlightSafety international
CITATION V ULTRA PILOT TRAINING MANUAL

1. **FLAPS, SPEED BRAKES, AILERON, AND TRIM TAB**—CONDITION AND SECURE

2. **STATIC WICKS**—CHECK (5)

3. **NAVIGATION, STROBE, AND LANDING AND RECOGNITION LIGHTS**—CONDITION

4. **FUEL TANK VENT**—CLEAR

5. **FUEL FILLER CAP**—SECURE

6. **DEICE BOOT**—CONDITION AND SECURE

7. **MAIN GEAR, DOOR, WHEEL, TIRE, BRAKE**—CONDITION AND SECURE

8. **FUEL FILTER DRAIN**—DRAIN

9. **FUEL QUICK DRAIN**—DRAIN AND CHECK FOR CONTAMINATION (6)

10. **HEATED LEADING EDGE**—CONDITION AND VENTS CLEAR

11. **ANTI-ICE BLEED AIR COOLING AIR INLET**—CLEAR

12. **WING INSPECTION LIGHT**—CONDITION

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13. **GENERATOR COOLING AIR INLET**—CLEAR

14. **ENGINE FAN DUCT AND FAN**—CONDITION

15. **FORWARD T_1 SENSOR**—CONDITION

16. **DORSAL FIN AIR INLET**—CLEAR

17. **SECONDARY CABIN DOOR SEAL**—CHECK FOR RIPS, TEARS AND FOLDING

APPENDIX A
TERMS AND ABBREVIATIONS

ACARS	Aircraft Communication Addressing & Reporting System
ACM	Air-cycle machine
ADF	Automatic direction finder
ADI	Attitude director indicator
ADS	Air data system
AFIS	Airborne flight information system
AFM	*Airplane Flight Manual*
AGRAS	Air ground radio telephone automated service
ALT	Altitude
ANT	Antenna
AP	Autopilot
APP	Approach
ASEL	Altitude preselect
ATC	Air traffic control
BC	Back course
BFO	Beat Frequency Oscillator
BITE	Built-in test equipment
CDI	Course deviation indicator
CDU	Control display unit
CG	Center of gravity
CRT	Cathode ray tube
DH	Decision height
DME	Distance measuring equipment
DMU	Data management unit
DR	Dead reckoning
DTRK	Desired track
DTU	Data transfer unit
DU	Display unit
EADI	Electronic attitude director indicator
EFIS	Electronic flight instrument system
ELT	Emergency locator transmitter
EMER	Emergency
EPU	External power unit
ESIS	Electronic standby instrument system
ESU	Electronic sequence unit
ET	Elapsed time
FCU	Fuel control unit
FD	Flight director
FM	High-powered frequency modulation
FMS	Flight management system
FPG	Flight guidance processor
FPS	Flight guidance system
GA	Go-around
GCU	Generator control unit

GMT	Greenwich mean time
GP	Glidepath
GPC	Global personal computer
GPWS	Ground proximity warning system
GS	Glide slope
GS	Ground speed (kts) or glide slope
GSPD	Ground speed
HDG	Heading
HDLC	High-level data link control
HF	High frequency
HPa	Hectopascals
HSI	Horizontal situation indicator
IAC	Integrated avionics computers
IAS	Indicated airspeed
IFR	Instrument flight rules
ILS	Instrument landing system
ITT	Interstage turbine temperature
KT	Knots
LOC	Localizer
LSB	Lower side band
MADC	Micro air data computers
MAP	Missed approach point
MDA	Minimum descent altitude
MFD	Multifunction display
MSG	Message
N_2	Turbine RPM
NAV	Navigation radio or mode
NM	Nautical miles
PAST	Pilot activates self test
PFD	Primary flight display
PGE	Page
RA	Resolution advisory
RAT	Ram-air temperature
RMU	Radio management unit
RSB	Radio Service Bus
SG	Symbol generator
SPD	Speed
SPPR	Single-point pressure refueling
STA EL	Station elevation
TA	Traffic advisory
TCAS	Traffic alert and collision avoidance system
TCS	Touch control steering
TTG	Time to go
UFDR	Universal flight data recorder
UHF	Ultra-high frequency
USB	Upper side band
VFR	Visual flight rules
V_{MO}/ M_{MO}	Maximum operating airspeed or Mach number
VNAV	Vertical navigation (FMS)

VOR	VHF omnidirectional radio range
VORTAC	Electronic navigation system
VS	Vertical speed
VS1	Stall speed in a defined configuration
VSI	Vertical speed indicator
VTA	Vertical track alert
WPT	Waypoint
XTK	Offset
YD	Yaw damper
ZFW	Zero fuel weight

ANSWERS TO QUESTIONS

CHAPTER 2
1. C
2. D
3. D
4. B
5. C
6. D
7. C
8. D
9. B
10. D
11. D
12. A
13. C
14. B
15. D
16. A
17. B
18. D
19. C
20. D
21. A
22. B
23. C
24. A
25. D

CHAPTER 3
1. A
2. D
3. D
4. D
5. A
6. C

CHAPTER 4
1. C
2. D
3. A

CHAPTER 5
1. C
2. B
3. D
4. C
5. A
6. D
7. B
8. A
9. D
10. D
11. D

CHAPTER 7
1. B
2. A
3. B
4. B
5. D
6. A
7. B
8. B
9. A
10. C
11. D

CHAPTER 8
1. C
2. D
3. A
4. D
5. B
6. A

CHAPTER 9
1. B
2. D
3. A
4. C

CHAPTER 10
1. C
2. B
3. D
4. A
5. D
6. C
7. D
8. B
9. A
10. D
11. C
12. D
13. B
14. C

CHAPTER 11
1. D
2. B
3. A
4. A
5. B
6. B
7. C

CHAPTER 12
1. B
2. B
3. D
4. A
5. D
6. B

CHAPTER 13
1. D
2. D
3. B
4. C
5. C
6. D
7. A
8. B
9. D
10. D
11. C
12. A
13. B

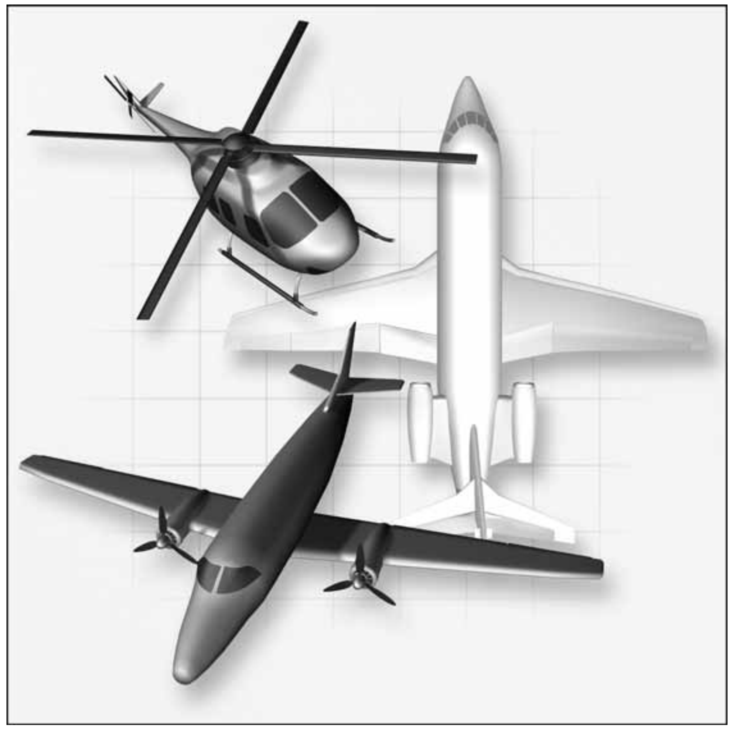
CHAPTER 14
1. B
2. D
3. A
4. B
5. C
6. A
7. B
8. C
9. C
10. C
11. B
12. B
13. D
14. B
15. A
16. D
17. C
18. C

CHAPTER 15
1. B
2. C
3. A
4. B
5. A
6. D
7. B
8. C
9. B
10. B
11. B
12. A

CHAPTER 17
1. C
2. D
3. A
4. B
5. A
6. D

APPENDIX C

LIMITATIONS AND SPECIFICATIONS



OPERATING LIMITATIONS
TABLE OF CONTENTS

OPERATING LIMITATIONS

NOTICE

CERTIFICATION AND OPERATIONAL LIMITATIONS ARE CONDITIONS OF THE TYPE AND AIRWORTHINESS CERTIFICATES AND MUST BE COMPLIED WITH AT ALL TIMES AS REQUIRED BY LAW.

CERTIFICATION STATUS

This airplane is certified in accordance with FAR 25.

WEIGHT LIMITATIONS

Maximum Design Ramp Weight	16,500 Pounds
Maximum Design Takeoff Weight	16,300 Pounds
Maximum Design Landing Weight	15,200 Pounds
Maximum Design Zero Fuel Weight	12,200 Pounds

Takeoff weight is limited by the most restrictive of the following requirements:

Maximum Certified Takeoff Weight	16,300 Pounds
Maximum Takeoff Weight Permitted by Climb Requirements	Refer to Procedures for Use of Takeoff Performance Tables in Section IV
Takeoff Field Length	Refer to Procedures for Use of Takeoff Performance Tables in Section IV

Landing weight is limited by the most restrictive of the following requirements:

Maximum Certified Landing Weight	15,200 Pounds
Maximum Landing Weight Permitted by Climb Requirements or Brake Energy Limit	Refer to Procedures for Use of Approach and Landing Performance Tables in Section IV
Landing Distance	Refer to Procedures for Use of Approach and Landing Performance Tables in Section IV

CENTER-OF-GRAVITY LIMITS

Center-of-Gravity Moment Envelope	Refer to Figure 2-1

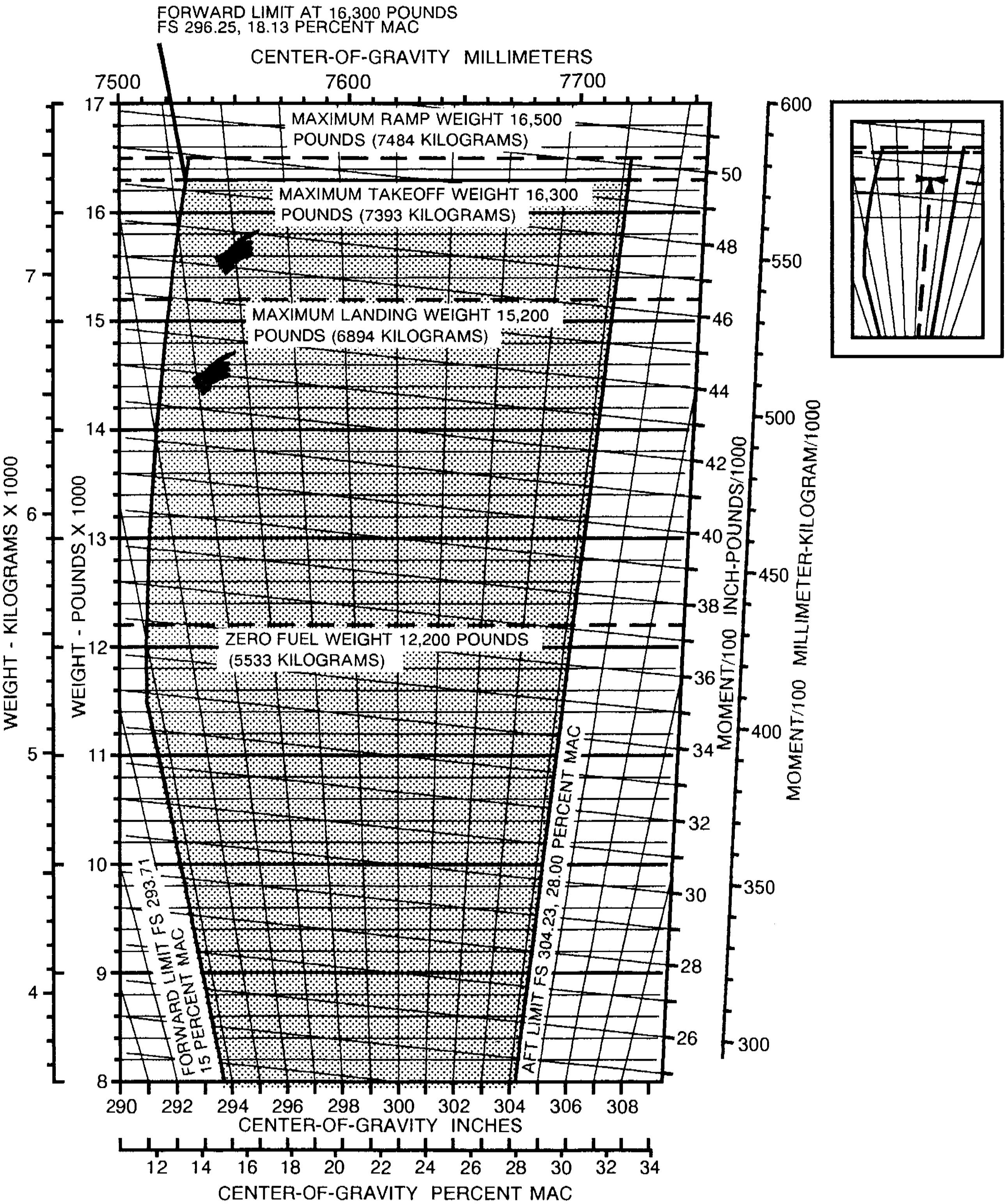
WEIGHT AND BALANCE DATA

The airplane must be operated in accordance with the approved loading schedule. (Refer to Weight and Balance Data Sheet and Model 560 Citation V Weight and Balance Manual.)

POWERPLANT LIMITATIONS

Engine Type	Pratt and Whitney Canada Inc. JT15D-5D Turbofan
Engine Operating Limits	Refer to Figure 2-2
Inter-Turbine Temperatures Limits	Refer to Figure 2-3
Engine Overspeed Limits	Refer to Figure 2-4
Takeoff/Go Around Thrust Setting	Refer to Figure 4-9
Maximum Continuous Thrust Setting	Refer to Figure 4-10

CENTER-OF-GRAVITY MOMENT ENVELOPE



FORM NUMBER 1906, 16 May 1994

Figure 2-1

ENGINE OPERATING LIMITS

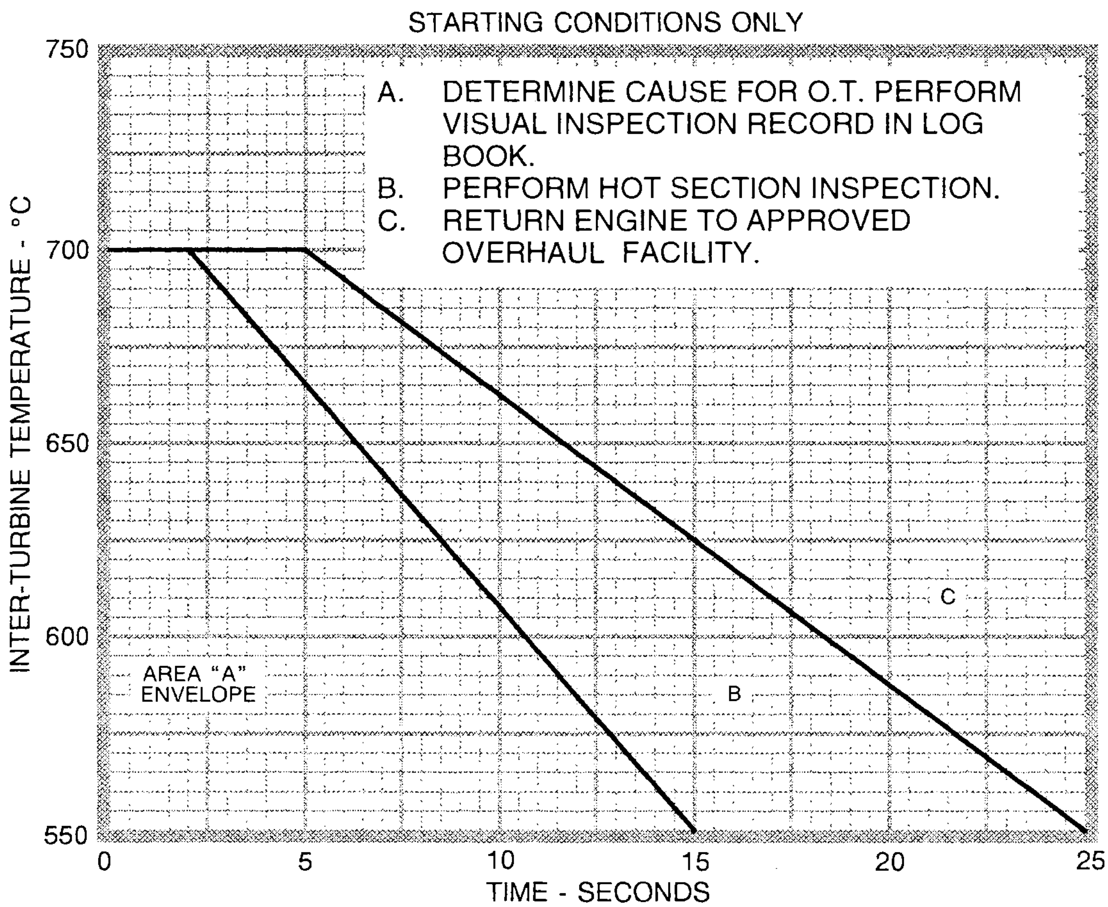
OPERATING CONDITIONS	OPERATING LIMITS					
THRUST SETTING	TIME LIMIT (MINUTES)	ITT TEMPERA-TURE °C	N_2 % TURBINE RPM	N_1 % FAN RPM	OIL PRESSURE PSIG (NOTE 2)	OIL TEMPERATURE °C
TAKEOFF	5 (NOTE 5)	720	97	100 (NOTE 4)	60 TO 90 (NOTE 3)	10 TO 121
MAXIMUM CONTINUOUS	CONTINUOUS	700	97	100 (NOTE 4)	60 TO 90	10 TO 121
FLIGHT IDLE	CONTINUOUS	580	52 (MIN)	---	40 (MIN)	–40 TO 121
GROUND IDLE	CONTINUOUS	580	46 (MIN)	---	40 (MIN)	–40 TO 121
STARTING	---	550 (NOTE 1)	---	---	---	–40 (MIN)
TRANSIENT	---	740	97	101.9	(NOTE 3)	–18 TO 129

NOTES

1. Refer to Figure 2-3.
2. Normal oil pressures are 60 to 90 PSIG above 60% TURBINE RPM. Oil pressures below 60 PSIG are undesirable and should be tolerated only for the completion of the flight, preferably at reduced power setting. Oil pressures below 40 PSIG are unsafe and require that either the engine be shut down or a landing be made as soon as possible, using the minimum power required to sustain flight.
3. The maximum transient oil pressure can be 100 PSIG for 90 seconds.
4. Refer to the appropriate thrust setting charts in Section IV (Standard Charts) for % FAN RPM setting.
5. Takeoff ratings that are normally limited to 5 minutes duration may be used for up to 10 minutes for One Engine Inoperative operations without adverse effects on engine airworthiness.

Figure 2-2

INTER-TURBINE TEMPERATURE LIMITS



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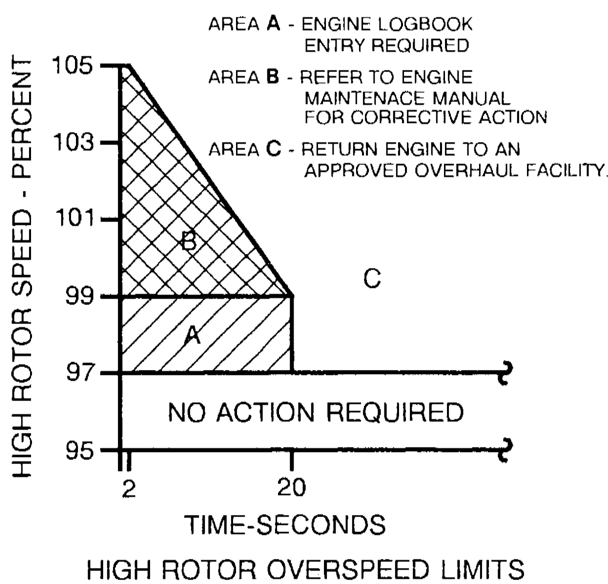
ALL CONDITIONS EXCEPT STARTING

If the Inter-Turbine Temperature (ITT) exceeds 720°C during takeoff, or if 700°C is exceeded at any time other than takeoff, refer to Chapter 77 of the Maintenance Manual and Engine Maintenance Manual.

Figure 2-3

ENGINE OVERSPEED LIMITS



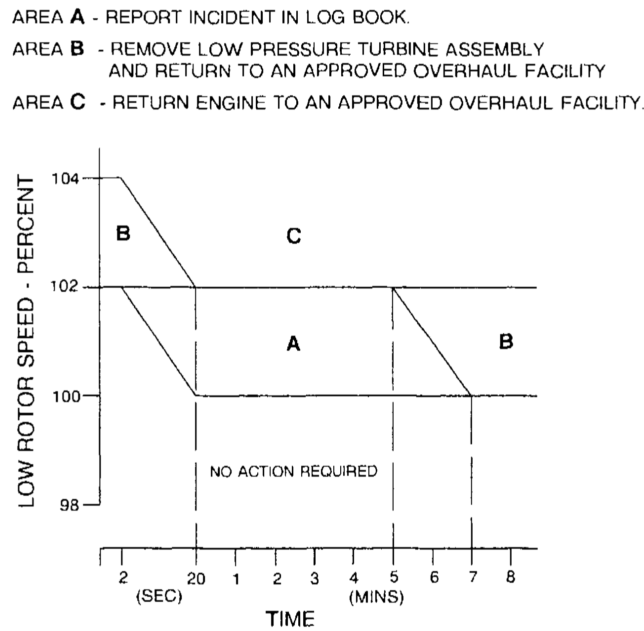


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Figure 2-4

ENGINE FAN INSPECTION

To assure accurate fan speed thrust indication, inspect the fan for damage prior to each flight.

NOTE

Refer to the exterior inspection in the Normal Procedures Section of this manual for engine duct and fan inspection.

BATTERY AND STARTER CYCLE LIMITATIONS

Starter Limitation with external power unit or generator assisted cross start as the starter power source	Two engine starts per 30 minutes. Two cycles of operation with a 90-second rest period between cycles is permitted.
Starter Limitation with battery as a power source	Three engine starts per 30 minutes. Three cycles of operation with a 90-second rest period between cycles is permitted.
Battery Limitation	Three engine starts per hour. Refer to notes 2 and 3.

NOTE

1. If battery limitation is exceed, a deep cycle including a capacity check must be accomplished to detect possible cell damage. Refer to Chapter 24 of the Maintenance Manual for procedure.
2. Three generator assisted cross starts are equal to one battery start.

(Continued Next Page)

BATTERY AND STARTER CYCLE LIMITATIONS (Continued)

NOTE

3. If an external power unit is used for start, no battery cycle is counted.
4. Use of an external power source with voltage in excess of 28 VDC or current in excess of 1000 amps may damage the starter.

PROLONGED GROUND OPERATION

Continuous engine ground static operation up to and including five minutes at takeoff thrust is limited to ambient temperatures not to exceed 39°C above ISA. (Refer to Figure 4-8).

Continuous ground operation of the starter-generator above 125 amperes at ground idle 46% turbine speed or 225 amperes at flight idle 52% turbine speed is prohibited.

Limit ground operation of pitot/static heat to two minutes to preclude damage to the pitot static tubes and angle-of-attack probe.

WINDSHIELD ICE PROTECTION FLUID

Use TT-I-735 isopropyl alcohol for windshield anti-ice.

HYDRAULIC FLUID

Use Skydrol 500A, B, B-4, C, or LD-4; or Hyjet, Hyjet W, III, IV, IVA or IVA Plus only.

APPROVED OILS

The following oils are approved for use:

MOBIL JET OIL II	EXXON TURBO OIL 2380	AEROSHELL TURBINE OIL 500
MOBIL JET OIL 254	CASTROL 5000	AEROSHELL TURBINE OIL 560
	ROYCO TURBINE OIL 560	ROYCO TURBINE OIL 500

In addition, oils listed for the engine in the latest revision to Pratt and Whitney Canada Inc. Service Bulletin Number 7001 are approved.

CAUTION

WHEN CHANGING FROM AN EXISTING LUBRICANT FORMULATION TO A "THIRD GENERATION" LUBRICANT FORMULATION (AEROSHELL TURBINE OIL 560 OR MOBIL JET 254), THE ENGINE MANUFACTURER STRONGLY RECOMMENDS THAT SUCH A CHANGE SHOULD ONLY BE MADE WHEN AN ENGINE IS NEW OR FRESHLY OVERHAULED. FOR ADDITIONAL INFORMATION ON USE OF THIRD GENERATION OILS, REFER TO ENGINE MANUFACTURER'S PERTINENT OIL SERVICE BULLETINS.

Should it be necessary to replenish oil consumption losses when oil of the same brand (as tank contents) is unavailable, then the following requirements apply:

(Continued Next Page)

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) FAA Approved Airplane Flight Manual Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section II, Operating Limitations, page 2-9, FUEL LIMITATIONS, add a limitation and delete a step.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) FAA Approved Airplane Flight Manual, adjacent to page 2-9.
Removal Instructions:	This temporary change must be removed and discarded once SB560-28-10 has been complied with.

In Section II, Operating Limitations, page 2-9, FUEL LIMITATIONS, change the following:

FUEL LIMITATIONS

ADD THE FOLLOWING LIMITATIONS:

Minimum fuel required for all operations is 600 pounds per side.

Fuel crossfeed is prohibited in descents.

DELETE THE FOLLOWING STEP:

*Boost Pumps - ON; when low fuel lights illuminate or at 185 pounds or less indicated fuel.

APPROVED BY ____________
for Ronald K. Rathgeber, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL MAR 4 2004

APPROVED OILS (Continued)

For contingency purposes, oil replenishment using any other approved oil brand listed is acceptable provided:

1. The total quantity of added oil does not exceed two U.S. quarts in any 400-hour period.
2. If it is required to add more than two U.S. quarts of dissimilar oil brands, drain and flush complete oil system and refill with an approved oil in accordance with Engine Maintenance Manual instructions.

Should oils of nonapproved brands or of different viscosities become intermixed, drain and flush complete oil system and refill with an approved oil in accordance with Engine Maintenance Manual instructions.

Minimum oil temperature for starting is –40°C.

SINGLE POINT REFUELING LIMITATION (if equipped)

Single point refueling operations must be accomplished per the procedures contained on the placard installed on the single point refueling access door. Refueling pressure range is 15 to 60 PSI, maximum defueling pressure is –6 PSI.

FUEL LIMITATIONS

Anti-icing additive must be added to all approved fuels not presently containing the additive.

*Boost Pumps - ON; when low fuel lights illuminate or at 185 pounds or less indicated fuel.

The following fuels are approved for use in accordance with Figure 2-5.

COMMERCIAL KEROSENE JET A, JET A-1, JET A-2, JET B, JP-4, JP-5 and JP-8 per CPW 204 specification.

AVIATION GASOLINE, MIL-G-5572, all grades, permitted for a maximum of 50 hours or 3500 gallons between overhauls providing:

1. Pilot confirms fuel temperature within limits.
2. Maximum ambient air temperature (takeoff) +32°C.
*3. Boost Pumps - ON.
4. Hours used entered in Engine Logbook. For record keeping purposes, assume one hour of engine operation equals 70 gallons of gasoline.

CAUTION

THESE FUELS, EXCEPT MILITARY JP-4, JP-5 and JP-8, REQUIRE THE ADDITION OF ANTI-ICING ADDITIVE (PER MIL-I-27686 OR MIL-I-85470). REFER TO SECTION III, NORMAL PROCEDURES, FUEL ANTI-ICE ADDITIVES, FOR PROCEDURES TO FOLLOW WHEN BLENDING AND CHECKING FUEL ANTI-ICE ADDITIVES.

*To crossfeed, turn boost pump OFF on side opposite selected tank.

FUEL LIMITATIONS AND ADJUSTMENTS

FUEL GRADE	FUEL SPECIFICATION	MINIMUM FUEL TEMPERATURE (TAKEOFF)	MAXIMUM FUEL TEMPERATURE (TAKEOFF)	MAXIMUM ALTITUDE	FUEL CONTROL DENSITY ADJUSTMENT FOR OPTIMUM ENGINE ACCELERATION
JET A	ASTM-D1655	-35°C	+50°C	45,000 FEET	0.81
JET A-1	ASTM-D1655	-40°C	+50°C	45,000 FEET	0.81
JET B	ASTM-D1655	-45°C	+50°C	45,000 FEET	0.79
JP-4	MIL-T-5624	-54°C	+50°C	45,000 FEET	0.79
JP-5	MIL-T-5624	-40°C	+50°C	45,000 FEET	0.81
JP-8	MIL-T-83133	-40°C	+50°C	45,000 FEET	0.81
AVIATION GASOLINE	MIL-G-5572 ASTM-D910	-54°C	+32°C	18,000 FEET	0.73

Maximum Asymmetrical Fuel Differential for Normal Operations .... 200 Pounds
Maximum Emergency Asymmetrical Fuel Differential .... 600 Pounds

NOTE

Flight characteristics requirements were not demonstrated with unbalanced fuel above 200 pounds. A lateral fuel imbalance of 600 pounds has been demonstrated for emergency return.

Figure 2-5

UNUSABLE FUEL

Fuel remaining in the fuel tanks when the fuel quantity indicator reads zero is not usable in flight.

SPEED LIMITATIONS

Maximum Operating Limit Speeds

M_{MO} (Above 28,907 Feet) .... 0.755 Mach (Indicated)
V_{MO} (Between 8000 and 28,907 Feet) .... 292 KIAS
V_{MO} (Below 8000 Feet) .... 262 KIAS

The maximum operating limit speeds may not be deliberately exceeded in any regime of flight (climb, cruise or descent) unless a higher speed is authorized for flight test or pilot training.

Maximum Maneuvering Speeds - V_A .... Refer to Figure 2-6

Full application of rudder and aileron controls as well as maneuvers that involve angles-of-attack near the stall should be confined to speeds below maximum maneuvering speed.

(Continued Next Page)

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru –0538.
Description of Change:	Section II, Operating Limitations, Speed Limitations, replace Minimum Operating Limit Speeds information that was previously added in 56FMA TC-R11-18.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual adjacent to page 2-10. This temporary change replaces 56FMA TC-R11-18 in its entirety.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section II, Operating Limitations, Speed Limitations, on page 2-10, add the following Minimum Operating Limit Speeds information just after the Maximum Operating Limit Speeds:

Minimum Operating Limit Speeds
- Sustained flight in icing conditions .... 160 KIAS
  (except takeoff, approach and landing)
- Approach and landing
  - Anti-ice ON .... V_{REF} + 7 KIAS
  - Anti-ice OFF .... V_{REF}

WARNING

STICK SHAKER MAY NOT ACTIVATE PRIOR TO BUFFET/ROLL-OFF IF AIRSPEED IS REDUCED BELOW THE APPROPRIATE MINIMUM SPEED.

CAUTION

WITH THE ANTI-ICE SELECTED ON, THE V_{REF}/V_{APP} SPEEDS AND LANDING DISTANCES AND THE MAXIMUM LANDING WEIGHT PERMITTED BY CLIMB REQUIREMENTS OR BRAKE ENERGY LIMITS MUST BE ADJUSTED IN ACCORDANCE WITH FIGURE 4-34.

NOTE

Sustained operation below the minimum operating limit speed in any regime of flight is prohibited unless a lower speed is authorized for flight test or pilot training/checking.

APPROVED BY DM Baker
fa **Margaret Kline, Manager**
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas
DATE OF APPROVAL 10/2/07

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes (560-0260 thru -0538) incorporating SB560-32-27.
Description of Change:	Section II, Operating Limitations, Takeoff and Landing Operational Limits revise a sentence.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 2-11.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section II, Operating Limitations, Takeoff and Landing Operational Limits, revise the last sentence to read:

TAKEOFF AND LANDING OPERATIONAL LIMITS

The nosewheel must be in firm contact with the ground prior to deploying thrust reversers.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section II, Operating Limitations, page 2-11, add frost, ice, snow, and slush takeoff limitations, below current Takeoff and Landing Operational Limits.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 2-11.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section II OPERATING LIMITATIONS, page 2-11, Add frost, ice, snow, and slush takeoff limitations, below current Takeoff and Landing Operational Limits:

TAKEOFF AND LANDING OPERATIONAL LIMITS

Takeoff is prohibited with the following forms of contamination:

1. With frost adhering to the following critical areas:
   - Wing Leading Edge
   - Upper Wing Surface
   - Windshield
2. With ice, snow or slush adhering to the following critical areas:
   - Wing Leading Edge and Upper Wing Surface
   - Flight Control Surfaces including all hinge gaps
   - Horizontal Stabilizer
   - Vertical Stabilizer
   - Engine Inlets
   - Top of Engine Pylons
   - Top of Fuselage
   - Windshield
   - All Static Ports
   - Angle of Attack Vanes
   - Upper surface of nose forward of the windshield

   NOTE

   Refer to Section VII for information regarding Ground Deicing and Anti-icing procedures.
3. A visual and tactile (hand on surface) check of the wing leading edge and wing upper surface must be performed to ensure the wing is free from frost, ice, snow, or slush when the outside air temperature is less than 10°C (50°F) or if it cannot be determined that the wing fuel temperature is above 0°C (32°F) and any of the following conditions exist:

   a. There is visible moisture present (rain, drizzle, sleet, snow, fog, etc.); or
   b. Water is present on the wing upper surface; or
   c. The difference between the dew point and the outside temperature is 3°C (5°F) or less; or
   d. The atmospheric conditions have been conducive to frost formation.

SPEED LIMITATIONS (Continued)

Maximum Flap Extended Speed - V_{FE}	
Full Flaps - LAND Position (35°)	173 KIAS
Partial Flaps - T.O. (7°), T.O. & APPR Position (15°)	200 KIAS
Maximum Landing Gear Extended Speed - V_{LE}	292 KIAS
Maximum Landing Gear Operating Speed - V_{LO} (Extending)	250 KIAS
- V_{LO} (Retracting)	200 KIAS
Maximum Speed Brake Operation Speed - V_{SB}	No Limit
Minimum Control Speeds (V_{MCA} and V_{MCG})	Refer to Section IV, Performance General
Autopilot Operation	292 KIAS or 0.755 MACH

TAKEOFF AND LANDING OPERATIONAL LIMITS

Maximum Altitude Limit	14,000 Feet
Maximum Tailwind Components	10 Knots
Maximum Water/Slush on Runway	0.5 Inches
Maximum Ambient Temperature	ISA +39°C (Refer to Figures 2-7 and 4-8)
Minimum Ambient Temperature	–54°C

The autopilot and yaw damper must be OFF for takeoff and landing.

Goodyear part number 184F08-1 or 184F13-5 and part number 031-613-8 (manufactured by BFGoodrich/Michelin) are the only nose tires approved. The nose tire must be inflated to 120±5 PSI.

With the Goodyear 184F13-5 tire installed, no takeoffs are permitted on precipitation covered runways with flaps 7° above 10,000 feet pressure altitiude. No flaps 7° takeoffs are allowed on precipitation covered runways with any tailwind above 6000 feet pressure altitude.

Maximum Tire Ground Speed	165 Knots

Vertical navigation system must be OFF below 500 feet AGL.

Takeoffs and landings are limited to paved runways unless equipped with optional Gravel Runway Modification, either factory installed or through incorporation of SB560-32-03.

The nosewheel must be in firm contact with the ground prior to extending speed brakes and/or deploying thrust reversers.

APPROACH AND LANDING IN ICING CONDITIONS

When any residual ice is present or can be expected during approach and landing, V_{REF} and V_{APP} must be increased. V_{REF} and V_{APP}, the landing distance, and the maximum landing weight permitted by brake energy must be corrected per Figure 4-32 (refer to Section IV, Performance - Approach and Landing). Engine anti-ice must be on to maintain adequate stall warning margin.

ENROUTE OPERATIONAL LIMITS

Maximum Operating Altitude	45,000 Feet
Maximum Ambient Temperature	Refer to Figure 2-7
Minimum Ambient Temperature	Refer to Figure 2-7
Generator Load	300 Amperes

OPERATIONS AUTHORIZED

This airplane is approved for day and night, VFR, IFR flight and flight into known icing conditions.

MAXIMUM MANEUVERING SPEEDS

EXAMPLE:

Pressure Altitude - 25,000 FEET
Weight - 14,500 POUNDS
Maximum Maneuvering Speed - 202 KNOTS

A35063

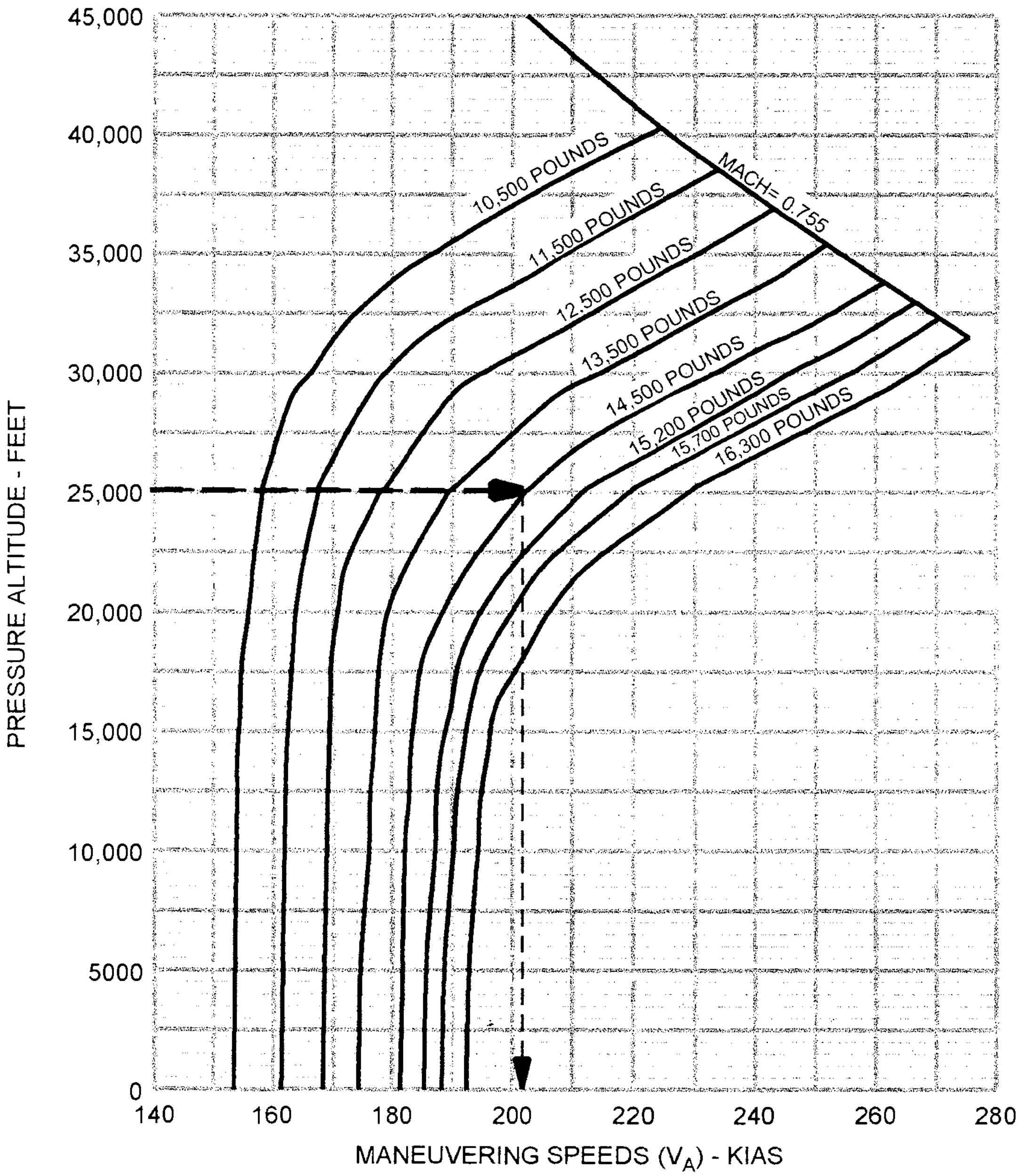


Figure 2-6

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publications Affected:	All Cessna Citation Airplane Flight Manuals for Models 500, 501, 525, 525A, 525B, 550, S550, 551, 560, 560XL, 650, 680, and 750.
Description of Change:	Section II, Operating Limitations, MAXIMUM MANEUVERING SPEEDS, add a WARNING.
Filing Instructions:	Insert this information in Section II, Operating Limitations, MAXIMUM MANEUVERING SPEEDS adjacent to, or in front of the page containing the MANEUVERING SPEEDS chart.
Removal Instructions:	Remove and discard when the latest revision containing this information has been collated into the basic FAA Approved Airplane Flight Manual.
Exception:	Disregard this temporary change only if your Citation Airplane Flight Manual previously incorporated the warning shown below, on the specified page, in the specified area.

Add this WARNING in Section II, Operating Limitations, MAXIMUM MANEUVERING SPEEDS, below the MANEUVERING SPEEDS chart.

WARNING

AVOID RAPID AND LARGE ALTERNATING CONTROL INPUTS, ESPECIALLY IN COMBINATION WITH LARGE CHANGES IN PITCH, ROLL, OR YAW (E.G. LARGE SIDESLIP ANGLES), AS THEY MAY RESULT IN STRUCTURAL FAILURES AT ANY SPEED, INCLUDING BELOW VA.

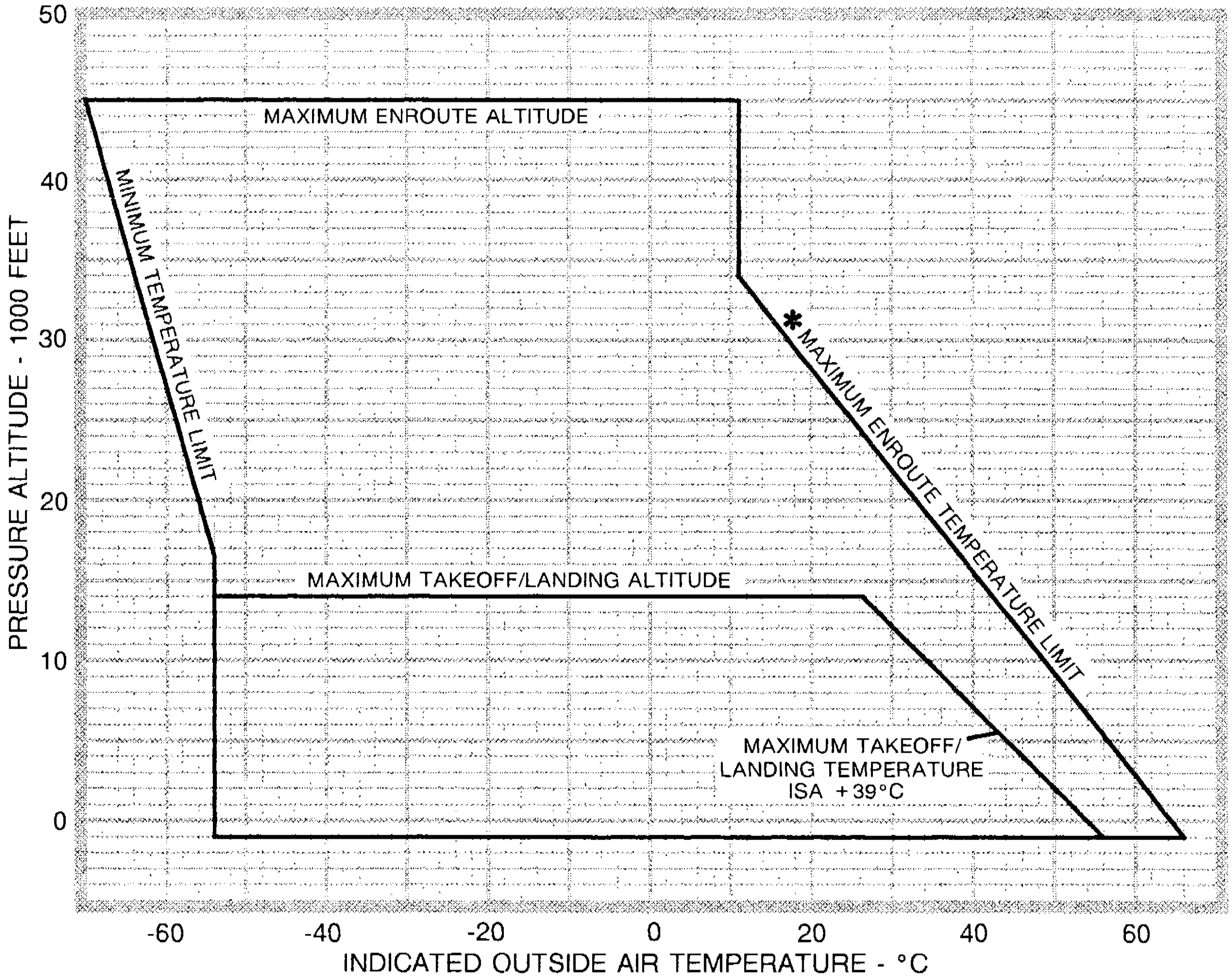
APPROVED BY DMB

Ronald K. Rathgeber, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 1/28/05

FMTC-ALL-01

TAKEOFF/LANDING/ENROUTE TEMPERATURE LIMITATIONS



5684C6006

* Maximum Enroute Operating Temperature Limit is ISA +39°C ambient temperature adjusted for Ram Rise (refer to Figure 4-3 and 4-8) or the Indicated Outside Air Temperature from the above graph, whichever is less.

Figure 2-7

MINIMUM CREW

Minimum Flight Crew for All Operations .... 1 Pilot and 1 Copilot

LOAD FACTOR

In Flight
Flaps UP Position (0°) .... –1.44 to +3.6G at 16,300 Pounds
Flaps T.O., T.O. & APPR to LAND Position
(7° To 35°) .... 0.0 to +2.0G at 16,300 Pounds

These accelerations limit the angle-of-bank in turns and limit the severity of pull-up maneuvers.

Landing
Flaps - T.O. & APPR to LAND Position
(15° to 35°) .... +3.5G at 15,200 Pounds

CABIN PRESSURIZATION LIMITATIONS

Normal Cabin Pressurization Limitations 0.0 to 8.9 PSI, +0.1 or –0.1 PSI Differential

MANEUVERS

No acrobatic maneuvers, including spins, are approved. No intentional stalls permitted above 25,000 feet.

PASSENGER SEATS

The maximum number of seats is 13 (pilot, copilot, and 11 passengers). For all takeoffs and landings, seats must be fully upright and outboard, and the seat just aft of the emergency exit must be to the most aft position (toward rear of airplane). Passenger seat belts and shoulder harnesses must be fastened.

AVTECH AUDIO CONTROL PANEL (with Collins radios)

Operation of the audio panel in the passenger speaker (PASS SPKR) mode is limited to required passenger briefings or emergencies.

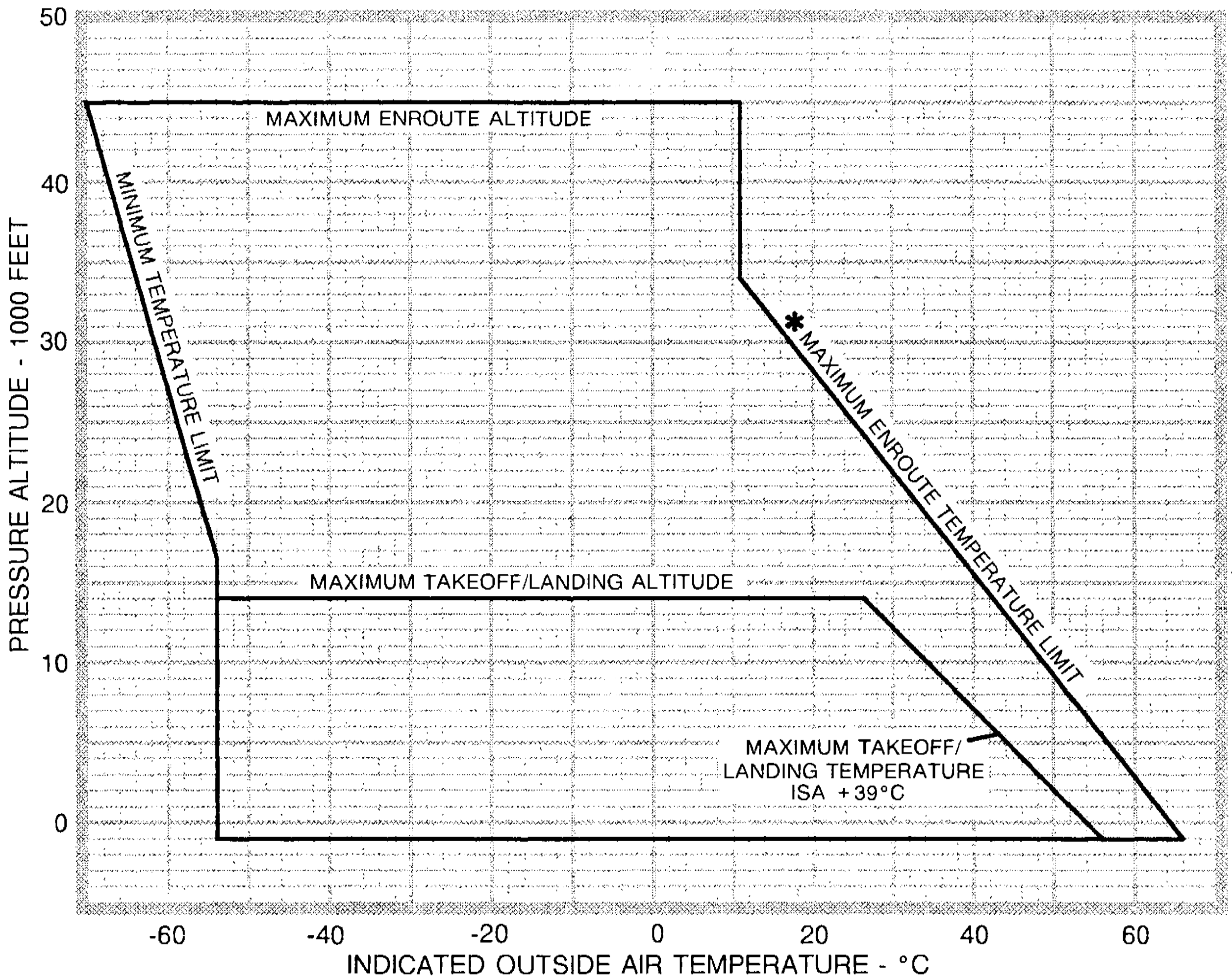
NOTE

- The same side cockpit speaker is normally muted when PASS SPKR is selected. All incoming transmissions and auxiliary audio warnings (GPWS and TCAS, if installed) will be received through the opposite side speaker. If both audio control switches are selected to PASS SPKR, both cockpit speakers become muted. Avoid selecting both switches to PASS SPKR at the same time.
- With passenger speaker mode selected and microphone selector switch selected to oxygen mask, the cockpit speaker will not receive voice interphone communications from the oxygen mask microphone of the opposite side pilot.
- Headset audio is not affected when (PASS SPKR) mode is selected.

AIRPLANE BATTERY

If the BATT O'TEMP light illuminates during ground operation, do not take off until after the proper maintenance procedures have been accomplished.

TAKEOFF/LANDING/ENROUTE TEMPERATURE LIMITATIONS



* Maximum Enroute Operating Temperature Limit is ISA +39°C ambient temperature adjusted for Ram Rise (refer to Figure 4-3 and 4-8) or the Indicated Outside Air Temperature from the above graph, whichever is less.

Figure 2-7

MINIMUM CREW

Minimum Flight Crew for All Operations .... 1 Pilot and 1 Copilot

LOAD FACTOR

In Flight

Flaps UP Position (0°) .... –1.44 to +3.6G at 16,300 Pounds

Flaps T.O., T.O. & APPR to LAND Position (7° To 35°) .... 0.0 to +2.0G at 16,300 Pounds

These accelerations limit the angle-of-bank in turns and limit the severity of pull-up maneuvers.

Landing

Flaps - T.O. & APPR to LAND Position (15° to 35°) .... +3.5G at 15,200 Pounds

CABIN PRESSURIZATION LIMITATIONS

Normal Cabin Pressurization Limitations 0.0 to 8.9 PSI, +0.1 or –0.1 PSI Differential

MANEUVERS

No acrobatic maneuvers, including spins, are approved. No intentional stalls permitted above 25,000 feet.

PASSENGER SEATS

The maximum number of seats is 13 (pilot, copilot, and 11 passengers). For all takeoffs and landings, seats must be fully upright and outboard, and the seat just aft of the emergency exit must be to the most aft position (toward rear of airplane). Passenger seat belts and shoulder harnesses must be fastened.

AVTECH AUDIO CONTROL PANEL (with Collins radios)

Operation of the audio panel in the passenger speaker (PASS SPKR) mode is limited to required passenger briefings or emergencies.

NOTE

- Depending on the modification level of the audio panel installed, all incoming transmissions and auxiliary audio warnings (GPWS and TCAS if installed) to both cockpit speakers may be lost if either audio panel has passenger speaker mode selected.
- With passenger speaker mode selected and microphone selector switch selected to oxygen mask, the cockpit speaker will not receive voice interphone communications from the oxygen mask microphone of the opposite side pilot.
- Headset audio is not affected when (PASS SPKR) mode is selected.

AIRPLANE BATTERY

If the BATT O'TEMP light illuminates during ground operation, do not take off until after the proper maintenance procedures have been accomplished.

ANGLE-OF-ATTACK/STICK SHAKER SYSTEM

The angle-of-attack and stall warning system must be operable and a satisfactory preflight must be performed in accordance with Section III, Normal Procedures.

The angle-of-attack indicating system may be used as a reference system but does not replace the airspeed display in the PFD as a primary instrument.

The angle-of-attack system can be used as a reference for approach speed (1.3 V_{S1}) at all airplane weights and center-of-gravity locations at zero, takeoff, takeoff/approach and landing flap positions.

If the stick shaker does not operate during the warning system test, or the angle-of-attack system is otherwise inoperative, it must be repaired before flight, except when the airplane is operated in accordance with an approved Minimum Equipment List.

INSTRUMENT MARKINGS

Left and Right Oil Pressure Indicators	Red Line - 40 PSI Yellow Band - 40 to 60 PSI Green Band - 60 to 90 PSI
Left and Right Turbine RPM Indicators	Flashing Red Light, Steady Digital Readout - 97% RPM Normal Operating - 46 to 97% RPM
Left and Right Oil Temperature Indicators	Red Line - 121°C Green Band - 0 to 121°C
Airspeed Indicator	Red Bands - 262 KIAS - 292 KIAS - 0.755 Mach
Left and Right Inter-Turbine Temperature Indicators	Red Line - 720°C Yellow Band - 700 to 720°C Red Triangle - 550°C Green Band - 150 to 700°C
Left and Right Fan RPM Indicators (Refer to Section IV for thrust setting limits)	Red Line - 100.0% Green Band - 25 to 100.0%
Left and Right Ammeter Indicators	Red Line - 300 Amps
Cabin Differential Pressure Indicator	Red Line - 8.9 PSI Green Arc - 0.0 to 8.9 PSI
Oxygen Pressure Indicator	Red Line - 2000 PSI Yellow Arc - 0.0 to 400 PSI Green Arc - 1600 to 1800 PSI
Brake and Gear Pneumatic Pressure Indicator (In Nose Compartment)	Wide Red Arc - Above 2050 PSI Narrow Red Arc - 0.0 to 1600 PSI Yellow Arc - 1600 to 1800 PSI Wide Green Arc - 1800 to 2050 PSI
Brake Hydraulic Accumulator Pressure Indicator	Light Green Arc - Static Pressure Dark Green Arc - Pressurized Pressure

AUTOPILOT

1. One pilot must remain in his seat with the seat belt fastened during all autopilot operations.
2. Autopilot operation is prohibited if any comparison monitor annunciator illuminates inflight.
3. Minimum use height: 1000 Feet AGL - Enroute
   300 Feet AGL - Non-precision Approach
   180 Feet AGL - Category I ILS Approach
4. Use of autopilot during Category II ILS operations is prohibited.

HONEYWELL PRIMUS 1000 FLIGHT GUIDANCE SYSTEM

1. The Honeywell, Primus 1000 Integrated Avionics System for the Citation Ultra Pilot's Manual must be immediately available to the flight crew (Honeywell publication number A28-1146-099 Revision 1, dated May 1996 or later appropriate revision).
2. Only Flight Director Category II operations are approved. Equipment operation shall be in accordance with the Category II manual.
3. The marker beacon audio muting shall not be activated at the middle marker on a Category II approach. If it is activated, the inner marker audio would still be muted because of the short time between markers.
4. Category II approaches shall be made in the following configuration only:
   a. Flaps - Land
   b. Gear - Down
   c. Both engines operating
   d. Airspeed - V_{REF}
5. EFIS ground operation with the pilot's NOSE AVN FAN FAIL annunciator light illuminated is limited to 30 minutes or until either PFD HOT or MFD HOT annunciator light illuminates, whichever occurs first.
6. Dispatch in instrument meteorological conditions is prohibited with the NOSE AVN FAN FAIL annunciator light illuminated. Dispatch in visual meteorological conditions is allowed with the AVN FAN annunciator illuminated, provided the NOSE AVN FAN FAIL ILLUMINATED ON GROUND abnormal procedures are followed.
7. Dispatch is prohibited if either the PFD HOT, MFD HOT or IC HOT annunciator light is illuminated.
8. Dispatch is prohibited following a flight where either a PFD HOT, MFD HOT or IC HOT annunciator light was illuminated, until the condition is identified and corrected.
9. The pilot's and copilot's PFDs must be installed and operational in the normal (non-reversionary) mode for takeoff.
10. The P-1000 system must be verified to be operational by a satisfactory preflight test as contained in the NORMAL procedures.
11. Dual PFD SG reversion to the MFD is prohibited.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Ultra FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2002.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section II, Operating Limitations, Honeywell Primus 1000 Flight Guidance System, add a limitation.
Filing Instructions:	Insert this temporary change in the Model 560 (560-0260 thru -0538) FAA Approved Airplane Flight Manual, adjacent to page 2-16, 2-16.1, 2-16.2, or 2-16.3.
Removal Instructions:	This temporary change must be removed and discarded once Alert Service Letter ASL560-34-21 and the associated referenced service bulletins have been complied with.

In Section II, Operating Limitations, Honeywell Primus 1000 Flight Guidance System, add the following limitation:

_.) When crossing the Outer Marker (OM) on glideslope during an ILS approach, the altitude must be verified with the altitude published for the procedure.

For aircraft with a single operating glideslope receiver, the approach may be flown using normal procedures no lower than Localizer Only Minimum Descent Altitude (MDA).

For aircraft with two operating glideslope receivers, the approach may be flown to the published minimums for the approach using normal procedures if both receivers are tuned to the localizer and both crew members are monitoring the approach using independent data and displays.

APPROVED BY ____________________

Ron Rathgeber, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 3/4/03

ANGLE-OF-ATTACK/STICK SHAKER SYSTEM

The angle-of-attack and stall warning system must be operable and a satisfactory preflight must be performed in accordance with Section III, Normal Procedures.

The angle-of-attack indicating system may be used as a reference system but does not replace the airspeed display in the PFD as a primary instrument.

The angle-of-attack system can be used as a reference for approach speed (1.3 V_{S1}) at all airplane weights and center-of-gravity locations at zero, takeoff, takeoff/approach and landing flap positions.

If the stick shaker does not operate during the warning system test, or the angle-of-attack system is otherwise inoperative, it must be repaired before flight, except when the airplane is operated in accordance with an approved Minimum Equipment List.

INSTRUMENT MARKINGS

Left and Right Oil Pressure Indicators	Red Line - 40 PSI Yellow Band - 40 to 60 PSI Green Band - 60 to 90 PSI
Left and Right Turbine RPM Indicators	Flashing Red Light, Steady Digital Readout - 97% RPM Normal Operating - 46 to 97% RPM
Left and Right Oil Temperature Indicators	Red Line - 121°C Green Band - 0 to 121°C
Airspeed Indicator	Red Bands - 262 KIAS - 292 KIAS - 0.755 Mach
Left and Right Inter-Turbine Temperature Indicators	Red Line - 720°C Yellow Band - 700 to 720°C Red Triangle - 550°C Green Band - 150 to 700°C
Left and Right Fan RPM Indicators (Refer to Section IV for thrust setting limits)	Red Line - 100.0% Green Band - 25 to 100.0%
Left and Right Ammeter Indicators	Red Line - 300 Amps
Cabin Differential Pressure Indicator	Red Line - 8.9 PSI Green Arc - 0.0 to 8.9 PSI
Oxygen Pressure Indicator	Red Line - 2000 PSI Yellow Arc - 0.0 to 400 PSI Green Arc - 1600 to 1800 PSI
Brake and Gear Pneumatic Pressure Indicator (In Nose Compartment)	Wide Red Arc - Above 2050 PSI Narrow Red Arc - 0.0 to 1600 PSI Yellow Arc - 1600 to 1800 PSI Wide Green Arc - 1800 to 2050 PSI
Brake Hydraulic Accumulator Pressure Indicator	Light Green Arc - Static Pressure Dark Green Arc - Pressurized Pressure

AUTOPILOT

1. One pilot must remain in his seat with the seat belt fastened during all autopilot operations.
2. Autopilot operation is prohibited if any comparison monitor annunciator illuminates inflight.
3. Minimum use height: 1000 Feet AGL - Enroute
   300 Feet AGL - Non-precision Approach
   180 Feet AGL - Category I ILS Approach.
4. Use of autopilot during Category II ILS operations is prohibited.

HONEYWELL PRIMUS 1000 FLIGHT GUIDANCE SYSTEM

1. The Honeywell Primus 1000 Integrated Avionics System for the Citation Ultra Pilot's Manual must be immediately available to the flight crew (Honeywell publication number A28-1146-099 Revision 1, dated May 1996 or later appropriate revision).
2. Only Flight Director Category II operations are approved. Equipment operation shall be in accordance with the Category II manual.

NOTE

Crew qualification is required to conduct Category II approaches.

3. The marker beacon audio muting shall not be activated at the middle marker on a Category II approach. If it is activated, the inner marker audio may also be muted because of the short time between the two markers.
4. Category II approaches shall be made in the following configuration only:
   a. Flaps - Land
   b. Landing Gear - Down
   c. Both engines operating
   d. Airspeed - V_{REF} +5 KIAS

NOTE

The landing distance and maximum landing weight permitted by brake energy limits must be corrected per Figure 4-34 (refer to Section IV, Performance, APPROACH AND LANDING).

5. EFIS ground operation with the pilot's NOSE AVN FAN FAIL annunciator light illuminated is limited to 30 minutes or until either PFD HOT or MFD HOT annunciator light illuminates, whichever occurs first.
6. Dispatch in instrument meteorological conditions is prohibited with the NOSE AVN FAN FAIL annunciator light illuminated. Dispatch in visual meteorological conditions is allowed with the AVN FAN annunciator illuminated, provided the NOSE AVN FAN FAIL ILLUMINATED ON GROUND abnormal procedures are followed.
7. Dispatch is prohibited if either the PFD HOT, MFD HOT or IC HOT annunciator light is illuminated.
8. Dispatch is prohibited following a flight where either a PFD HOT, MFD HOT or IC HOT annunciator light was illuminated, until the condition is identified and corrected.
9. The pilot's and copilot's PFDs must be installed and operational in the normal (non-reversionary) mode for takeoff.
10. The P-1000 system must be verified to be operational by a satisfactory preflight test as contained in the NORMAL procedures.
11. Dual PFD SG reversion to the MFD is prohibited.

ANGLE-OF-ATTACK/STICK SHAKER SYSTEM

The angle-of-attack and stall warning system must be operable and a satisfactory pre-flight must be performed in accordance with Section III, Normal Procedures.

The angle-of-attack indicating system may be used as a reference system but does not replace the airspeed display in the PFD as a primary instrument.

The angle-of-attack system can be used as a reference for approach speed (1.3 V_{S1}) at all airplane weights and center-of-gravity locations at zero, takeoff, takeoff/approach and landing flap positions.

If the stick shaker does not operate during the warning system test, or the angle-of-attack system is otherwise inoperative, it must be repaired before flight, except when the airplane is operated in accordance with an approved Minimum Equipment List.

INSTRUMENT MARKINGS

Left and Right Oil Pressure Indicators	Red Line - 40 PSI Yellow Band - 40 to 60 PSI Green Band - 60 to 90 PSI
Left and Right Turbine RPM Indicators	Flashing Red Light, Steady Digital Readout - 97% RPM Normal Operating - 46 to 97% RPM
Left and Right Oil Temperature Indicators	Red Line - 121°C Green Band - 0 to 121°C
Airspeed Indicator	Red Bands - 262 KIAS - 292 KIAS - 0.755 Mach
Left and Right Inter-Turbine Temperature Indicators	Red Line - 720°C Yellow Band - 700 to 720°C Red Triangle - 550°C Green Band - 150 to 700°C
Left and Right Fan RPM Indicators (Refer to Section IV for thrust setting limits)	Red Line - 100.0% Green Band - 25 to 100.0%
Left and Right Ammeter Indicators	Red Line - 300 Amps
Cabin Differential Pressure Indicator	Red Line - 8.9 PSI Green Arc - 0.0 to 8.9 PSI
Oxygen Pressure Indicator	Red Line - 2000 PSI Yellow Arc - 0.0 to 400 PSI Green Arc - 1600 to 1800 PSI
Brake and Gear Pneumatic Pressure Indicator (In Nose Compartment)	Wide Red Arc - Above 2050 PSI Narrow Red Arc - 0.0 to 1600 PSI Yellow Arc - 1600 to 1800 PSI Wide Green Arc - 1800 to 2050 PSI
Brake Hydraulic Accumulator Pressure Indicator	Light Green Arc - Static Pressure Dark Green Arc - Pressurized Pressure

AUTOPILOT

1. One pilot must remain in his seat with the seat belt fastened during all autopilot operations.
2. Autopilot operation is prohibited if any comparison monitor annunciator illuminates inflight.
3. Minimum use height: 1000 Feet AGL - Enroute
   300 Feet AGL - Non-precision Approach
   180 Feet AGL - Category I ILS Approach.

HONEYWELL PRIMUS 1000 FLIGHT GUIDANCE SYSTEM

1. The Honeywell Primus 1000 Integrated Avionics System for the Citation Ultra Pilot's Manual must be immediately available to the flight crew (Honeywell publication number A28-1146-099 Revision 3, or later appropriate revision).
2. Category II approaches are not approved.
3. EFIS ground operation with the pilot's NOSE AVN FAN FAIL annunciator light illuminated is limited to 30 minutes or until either PFD HOT or MFD HOT annunciator light illuminates, whichever occurs first.
4. Dispatch in instrument meteorological conditions is prohibited with the NOSE AVN FAN FAIL annunciator light illuminated. Dispatch in visual meteorological conditions is allowed with the AVN FAN annunciator illuminated, provided the NOSE AVN FAN FAIL ILLUMINATED ON GROUND abnormal procedures are followed.
5. Dispatch is prohibited if either the PFD HOT, MFD HOT or IC HOT annunciator light is illuminated.
6. Dispatch is prohibited following a flight where either a PFD HOT, MFD HOT or IC HOT annunciator light was illuminated, until the condition is identified and corrected.
7. The pilot's and copilot's PFDs must be installed and operational in the normal (non-reversionary) mode for takeoff.
8. The P-1000 system must be verified to be operational by a satisfactory preflight test as contained in the NORMAL procedures.
9. Dual PFD SG reversion to the MFD is prohibited.
10. VOR approaches without a valid co-located DME signal are prohibited with autopilot coupled or with flight director only.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Ultra FAA Approved Airplane Flight Manual Revision 11, Dated 2 October, 2002.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section II, Operating Limitations, Honeywell Primus 1000 Flight Guidance System, page 2-16.2 (Configuration BJ) or page 2-16.3 (Configuration BN), add information.
Filing Instructions:	Insert this temporary change in the Model 560 (560-0260 thru -0538) FAA Approved Airplane Flight Manual adjacent to page 2-16.2 (Configuration BJ) or page 2-16.3 (Configuration BN).
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the FAA Approved Airplane Flight Manual.

In Section II, Operating Limitations, Autopilot, page 2-16.2 (Configuration BJ) or page 2-16.3 (Configuration BN), add new step 4. Honeywell Primus 1000 Flight Guidance System, replace step 2, insert new steps 3 and 4 and renumber remaining steps:

AUTOPILOT

4. Use of autopilot during Category II ILS operations is prohibited.

HONEYWELL PRIMUS 1000 FLIGHT GUIDANCE SYSTEM

2. Only Flight Director Category II operations are approved. Equipment operation shall be in accordance with the Category II manual.

NOTE

Crew qualification is required to conduct Category II approaches.

3. The marker beacon audio muting shall not be activated at the middle marker on a Category II approach. If it is activated, the inner marker audio may also be muted because of the short time between the two markers.
4. Category II approaches shall be made in the following configuration only:
   a. Flaps - Land
   b. Landing Gear - Down
   c. Both engines operating
   d. Airspeed - V_{REF} +5 KIAS

NOTE

The landing distance and maximum landing weight permitted by brake energy limits must be corrected per Figure 4-34 (refer to Section IV, Performance, APPROACH AND LANDING).

APPROVED BY M Baker
for Ron Rathgeber, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 5/20/02

ANGLE-OF-ATTACK/STICK SHAKER SYSTEM

The angle-of-attack and stall warning system must be operable and a satisfactory preflight must be performed in accordance with Section III, Normal Procedures.

The angle-of-attack indicating system may be used as a reference system but does not replace the airspeed display in the PFD as a primary instrument.

The angle-of-attack system can be used as a reference for approach speed (1.3 V_{S1}) at all airplane weights and center-of-gravity locations at zero, takeoff, takeoff/approach and landing flap positions.

If the stick shaker does not operate during the warning system test, or the angle-of-attack system is otherwise inoperative, it must be repaired before flight, except when the airplane is operated in accordance with an approved Minimum Equipment List.

INSTRUMENT MARKINGS

Left and Right Oil Pressure Indicators	Red Line - 40 PSI Yellow Band - 40 to 60 PSI Green Band - 60 to 90 PSI
Left and Right Turbine RPM Indicators	Flashing Red Light, Steady Digital Readout - 97% RPM Normal Operating - 46 to 97% RPM
Left and Right Oil Temperature Indicators	Red Line - 121°C Green Band - 0 to 121°C
Airspeed Indicator	Red Bands - 262 KIAS - 292 KIAS - 0.755 Mach
Left and Right Inter-Turbine Temperature Indicators	Red Line - 720°C Yellow Band - 700 to 720°C Red Triangle - 550°C Green Band - 150 to 700°C
Left and Right Fan RPM Indicators (Refer to Section IV for thrust setting limits)	Red Line - 100.0% Green Band - 25 to 100.0%
Left and Right Ammeter Indicators	Red Line - 300 Amps
Cabin Differential Pressure Indicator	Red Line - 8.9 PSI Green Arc - 0.0 to 8.9 PSI
Oxygen Pressure Indicator	Red Line - 2000 PSI Yellow Arc - 0.0 to 400 PSI Green Arc - 1600 to 1800 PSI
Brake and Gear Pneumatic Pressure Indicator (In Nose Compartment)	Wide Red Arc - Above 2050 PSI Narrow Red Arc - 0.0 to 1600 PSI Yellow Arc - 1600 to 1800 PSI Wide Green Arc - 1800 to 2050 PSI
Brake Hydraulic Accumulator Pressure Indicator	Light Green Arc - Static Pressure Dark Green Arc - Pressurized Pressure

AUTOPILOT

1. One pilot must remain in his seat with the seat belt fastened during all autopilot operations.
2. Autopilot operation is prohibited if any comparison monitor annunciator illuminates inflight.
3. Minimum use height: 1000 Feet AGL - Enroute
   300 Feet AGL - Non-precision Approach
   180 Feet AGL - Category I ILS Approach.

HONEYWELL PRIMUS 1000 FLIGHT GUIDANCE SYSTEM

1. The Honeywell Primus 1000 Integrated Avionics System for the Citation Ultra Pilot's Manual must be immediately available to the flight crew (Honeywell publication number A28-1146-099 Revision 3, or later appropriate revision).
2. Category II approaches are not approved.
3. EFIS ground operation with the pilot's NOSE AVN FAN FAIL annunciator light illuminated is limited to 30 minutes or until either PFD HOT or MFD HOT annunciator light illuminates, whichever occurs first.
4. Dispatch in instrument meteorological conditions is prohibited with the NOSE AVN FAN FAIL annunciator light illuminated. Dispatch in visual meteorological conditions is allowed with the AVN FAN annunciator illuminated, provided the NOSE AVN FAN FAIL ILLUMINATED ON GROUND abnormal procedures are followed.
5. Dispatch is prohibited if either the PFD HOT, MFD HOT or IC HOT annunciator light is illuminated.
6. Dispatch is prohibited following a flight where either a PFD HOT, MFD HOT or IC HOT annunciator light was illuminated, until the condition is identified and corrected.
7. The pilot's and copilot's PFDs must be installed and operational in the normal (non-reversionary) mode for takeoff.
8. The P-1000 system must be verified to be operational by a satisfactory preflight test as contained in the NORMAL procedures.
9. Dual PFD SG reversion to the MFD is prohibited.
10. VOR approaches without a valid co-located DME signal are prohibited with autopilot coupled or with flight director only.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section II, Operating Limitations, Thrust Reversers, revise the last sentence.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 2-17 or 2-17.1.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section II, Operating Limitations, Thrust Reversers, revise the last sentence to read:

THRUST REVERSERS

The thrust reversers must be checked on the first flight of the day and the first flight after any maintenance action has been performed on the aircraft. Refer to Section III, Normal Procedures, Taxiing.

APPROVED BY MBaker

for Margaret Kline, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 3/9/06

STANDBY FLIGHT INSTRUMENTS

1. A satisfactory preflight test must be accomplished on the standby gyro system.
2. The standby flight display and HSI must be functioning prior to takeoff.

OXYGEN MASK

The pressure demand sweep-on oxygen mask must be properly stowed to qualify as a quick-donning oxygen mask.

NOTE

Headsets, eyeglasses or hats worn by the crew may interfere with the quick-donning capabilities of the oxygen masks.

SUPPLEMENTAL OXYGEN SYSTEM

Continuous use of the supplemental oxygen system with cabin altitude above 25,000 feet with passengers, or with cabin altitude above 37,000 feet, crew only, is prohibited.

HIGH FREQUENCY (HF) AUTOMATIC DIRECTION FINDER (ADF) SYSTEMS

The ADF bearing information may be erratic when keying the HF transmitter. Should this occur, disregard the ADF bearing during periods of transmission.

THRUST REVERSERS

Reverse thrust power must be reduced to the idle reverse detent position at 60 KIAS on landing roll.

Maximum reverse thrust setting is limited to 80.1% fan speed for ambient temperatures at or above -18°C and 76.6% fan speed for ambient temperatures below -18°C.

Maximum allowable thrust reverser deployed time is 15 minutes in any one hour period.

Engine static ground operation is limited to idle power (if thrust reversers are deployed).

Use of thrust reversers is prohibited during touch and go landings.

The thrust reverser(s) must be verified to be operational by the Before Takeoff test in Section III Normal Procedures.

GROUND IDLE SWITCH

The ground idle switch must be in HIGH position when conducting touch and go landings.

The ground idle switch must be in HIGH position when operating on the ground with engine anti-ice bleed ON.

TRIM

The elevator trim system check in Section III, Normal Procedures, must be satisfactorily completed prior to takeoff.

OPERATIONS IN SEVERE ICING CONDITIONS

WARNING

SEVERE ICING MAY RESULT FROM ENVIRONMENTAL CONDITIONS OUTSIDE OF THOSE FOR WHICH THE AIRPLANE IS CERTIFIED. FLIGHT IN FREEZING RAIN, FREEZING DRIZZLE, OR MIXED ICING CONDITIONS (SUPERCOOLED LIQUID WATER AND ICE CRYSTALS) MAY RESULT IN ICE BUILD-UP ON PROTECTED SURFACES EXCEEDING THE CAPABILITY OF THE ICE PROTECTION SYSTEM, OR MAY RESULT IN ICE FORMING AFT OF THE PROTECTED SURFACES. THIS ICE MAY NOT SHED WHEN THE ICE PROTECTION SYSTEMS ARE USED, AND MAY SERIOUSLY DEGRADE THE PERFORMANCE AND CONTROLABILITY OF THE AIRPLANE.

All wing icing inspection lights must be operative prior to flight into known or forecast icing conditions at night.

NOTE

This supersedes relief provided by the Master Minimum Equipment List.

Severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues:

1. Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.
2. Accumulation of ice on the upper surface of the wing aft of the protected area.

If one or more of these visual cues exist:

1. Immediately request priority handling from Air Traffic Control to facilitate a route or altitude change to exit the icing conditions.
2. Leave flaps in current position, do not extend or retract.
3. Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
4. If unusual or uncommanded roll control movement is observed, reduce angle-of-attack.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru –0538.
Description of Change:	Section II, Operating Limitations, replace "Operations in Severe Icing Conditions" information.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual adjacent to page 2-18.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section II, Operating Limitations, on page 2-18, replace the information under the subheading "OPERATIONS IN SEVERE ICING CONDITIONS" with the following information:

OPERATIONS IN SEVERE ICING CONDITIONS

In conjunction with the "Severe Icing Encounter" section in the Abnormal Procedures and the "Operations in Severe Icing Conditions" section in the Normal Procedures, this section meets the requirements to be in compliance with AD98-04-38.

WARNING

SEVERE ICING MAY RESULT FROM ENVIRONMENTAL CONDITIONS OUTSIDE OF THOSE FOR WHICH THE AIRPLANE IS CERTIFIED. FLIGHT IN FREEZING RAIN, FREEZING DRIZZLE, OR MIXED ICING CONDITIONS (SUPERCOOLED LIQUID WATER AND ICE CRYSTALS) MAY RESULT IN ICE BUILD-UP ON PROTECTED SURFACES EXCEEDING THE CAPABILITY OF THE ICE PROTECTION SYSTEM, OR MAY RESULT IN ICE FORMING AFT OF THE PROTECTED SURFACES. THIS ICE MAY NOT SHED WHEN THE ICE PROTECTION SYSTEMS ARE USED, AND MAY SERIOUSLY DEGRADE THE PERFORMANCE AND CONTROLLABILITY OF THE AIRPLANE.

All wing icing inspection lights must be operative prior to flight into known or forecast icing conditions at night.

NOTE

This supersedes relief provided by the Master Minimum Equipment List.

Severe icing conditions that exceed those for which the airplane is certificated shall be determined by one or more of the following visual cues:
1. Unusually extensive ice accumulation on the airframe and the windshield in areas not normally observed to collect ice.
2. Accumulation of ice on the upper surface of the wing aft of the protected area.

(Continued Next Page)

If one or more of these visual cues exist:
1. Immediately request priority handling from Air Traffic Control to facilitate a route or altitude change to exit the icing conditions.
2. Use of the autopilot is prohibited.
3. Leave flaps in current position, do not extend or retract.
4. Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
5. If unusual or uncommanded roll control movement is observed, reduce angle-of-attack.

Since the autopilot, when installed and operating, may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when:
1. Any of the visual cues for severe icing are encountered, or
2. Unusual lateral trim is required while the airplane is in icing conditions, or
3. Autopilot trim warnings are encountered while the airplane is in icing conditions.

APPROVED BY DM Baker
for **Margaret Kline, Manager**
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas
DATE OF APPROVAL 7/18/07

STANDBY FLIGHT INSTRUMENTS

1. A satisfactory preflight test must be accomplished on the standby gyro system.
2. The standby flight instruments, ATT, ALT/ASI and HSI must be functioning prior to takeoff.
3. The standby airspeed limitations listed on the ALT/KIAS placard apply only when both pilot's and copilot's PFD airspeed tapes are unreliable or inoperative.

OXYGEN MASK

The pressure demand sweep-on oxygen mask must be properly stowed to qualify as a quick-donning oxygen mask.

NOTE

Headsets, eyeglasses or hats worn by the crew may interfere with the quick-donning capabilities of the oxygen masks.

SUPPLEMENTAL OXYGEN SYSTEM

Continuous use of the supplemental oxygen system with cabin altitude above 25,000 feet with passengers, or with cabin altitude above 37,000 feet, crew only, is prohibited.

HIGH FREQUENCY (HF) AUTOMATIC DIRECTION FINDER (ADF) SYSTEMS

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THRUST REVERSERS

Reverse thrust power must be reduced to the idle reverse detent position at 60 KIAS on landing roll.

Maximum reverse thrust setting is limited to 80.1% fan speed for ambient temperatures at or above -18°C and 76.6% fan speed for ambient temperatures below -18°C.

Maximum allowable thrust reverser deployed time is 15 minutes in any one hour period.

Engine static ground operation is limited to idle power (if thrust reversers are deployed).

Use of thrust reversers is prohibited during touch and go landings.

The thrust reverser(s) must be verified to be operational by the Before Takeoff test in Section III Normal Procedures.

GROUND IDLE SWITCH

The ground idle switch must be in HIGH position when conducting touch and go landings.

The ground idle switch must be in HIGH position when operating on the ground with engine anti-ice bleed ON.

TRIM

The elevator trim system check in Section III, Normal Procedures, must be satisfactorily completed prior to takeoff.

OPERATIONS IN SEVERE ICING CONDITIONS

WARNING

SEVERE ICING MAY RESULT FROM ENVIRONMENTAL CONDITIONS OUTSIDE OF THOSE FOR WHICH THE AIRPLANE IS CERTIFIED. FLIGHT IN FREEZING RAIN, FREEZING DRIZZLE, OR MIXED ICING CONDITIONS (SUPERCOOLED LIQUID WATER AND ICE CRYSTALS) MAY RESULT IN ICE BUILD-UP ON PROTECTED SURFACES EXCEEDING THE CAPABILITY OF THE ICE PROTECTION SYSTEM, OR MAY RESULT IN ICE FORMING AFT OF THE PROTECTED SURFACES. THIS ICE MAY NOT SHED WHEN THE ICE PROTECTION SYSTEMS ARE USED, AND MAY SERIOUSLY DEGRADE THE PERFORMANCE AND CONTROLABILITY OF THE AIRPLANE.

All wing icing inspection lights must be operative prior to flight into known or forecast icing conditions at night.

NOTE

This supersedes relief provided by the Master Minimum Equipment List.

Severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues:
1. Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.
2. Accumulation of ice on the upper surface of the wing aft of the protected area.

If one or more of these visual cues exist:
1. Immediately request priority handling from Air Traffic Control to facilitate a route or altitude change to exit the icing conditions.
2. Leave flaps in current position, do not extend or retract.
3. Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
4. If unusual or uncommanded roll control movement is observed, reduce angle-of-attack.

CESSNA AIRCRAFT COMPANY
AIRWORTHINESS DIRECTIVE
SMALL AIRCRAFT & ROTORCRAFT

98-04-38 CESSNA AIRCRAFT COMPANY: Amendment 39-10350. Docket 97-NM-170-AD.

Applicability: Model 500, 501, 550, 551, and 560 series airplanes equipped with pneumatic deicing boots, certificated in any category.

NOTE 1: This AD applies to each airplane identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For airplanes that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (b) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not been eliminated, the request should include specific proposed actions to address it.

Compliance: Required as indicated, unless already accomplished.

To minimize the potential hazards associated with operating the airplane in severe icing conditions by providing more clearly defined procedures and limitations associated with such conditions, accomplish the following:

(a) Within 30 days after the effective date of this AD, accomplish the requirements of paragraphs (a)(1) and (a)(2) of this AD.

NOTE 2: Operators should initiate action to notify and ensure that flight crewmembers are apprised of this change.

(1) Revise the FAA-approved Airplane Flight Manual (AFM) by incorporating the following into the Limitations Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"WARNING

Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protection systems, and may seriously degrade the performance and controllability of the airplane.

• During flight, severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues. If one or more of these visual cues exists, immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the icing conditions.

- Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.

- Accumulation of ice on the upper surface of the wing aft of the protected area.

• Since the autopilot, when installed and operating, may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when any of the visual cues specified above exist, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in icing conditions.

• All wing icing inspection lights must be operative prior to flight into known or forecast icing conditions at night. [NOTE: This supersedes any relief provided by the Master Minimum Equipment List (MMEL).]"

(2) Revise the FAA-approved AFM by incorporating the following into the Normal Procedures Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"THE FOLLOWING WEATHER CONDITIONS MAY BE CONDUCIVE TO SEVERE IN-FLIGHT ICING:

• Visible rain at temperatures below 0 degrees Celsius ambient air temperature.

• Droplets that splash or splatter on impact at temperatures below 0 degrees Celsius ambient air temperature.

PROCEDURES FOR EXITING THE SEVERE ICING ENVIRONMENT:

These procedures are applicable to all flight phases from takeoff to landing. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as -18 degrees Celsius, increased vigilance is warranted at temperatures around freezing with visible moisture present. If the visual cues specified in the Limitations Section of the AFM for identifying severe icing conditions are observed, accomplish the following:

• Immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certificated.

• Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.

• Do not engage the autopilot.

• If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.

• If an unusual roll response or uncommanded roll control movement is observed, reduce the angle-of-attack.

• Do not extend flaps when holding in icing conditions. Operation with flaps extended can result in a reduced wing angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.

• If the flaps are extended, do not retract them until the airframe is clear of ice.

• Report these weather conditions to Air Traffic Control."

(b) An alternative method of compliance or adjustment of the compliance time that provides an acceptable level of safety may be used if approved by the Manager, Wichita Aircraft Certification Office (ACO), FAA, Small Airplane Directorate. The request shall be forwarded through an appropriate FAA Operations Inspector, who may add comments and then send it to the Manager, Wichita ACO.

NOTE 3: Information concerning the existence of approved alternative methods of compliance with this AD, if any, may be obtained from the Wichita ACO.

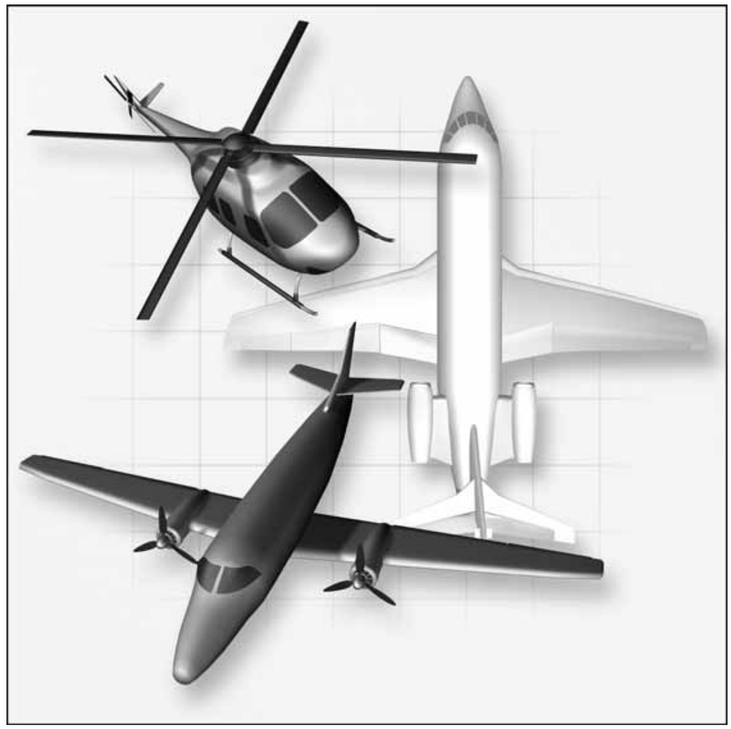
(c) Special flight permits may be issued in accordance with sections 21.197 and 21.199 of the Federal Aviation Regulations (14 CFR 21.197 and 21.199) to operate the airplane to a location where the requirements of this AD can be accomplished.

(d) This amendment becomes effective on March 25, 1998.

FOR FURTHER INFORMATION CONTACT:

Carlos L. Blacklock, Program Manager, Flight Test and Program Management, ACE-117W, FAA, Small Airplane Directorate, Wichita Aircraft Certification Office, 1801 Airport Road, Room 100, Mid-Continent Airport, Wichita, Kansas 67209; telephone (316) 946-4166; fax (316) 946-4407.

APPENDIX D
EXPANDED CHECKLISTS



OPERATING PROCEDURES
TABLE OF CONTENTS

OPERATING PROCEDURES - GENERAL

The operating procedures contained in this manual have been developed and recommended by Cessna Aircraft Company and are approved by the FAA for use in the operation of this airplane.

This section contains the emergency, abnormal and normal procedures for your airplane. For your convenience, definitions of these terms are listed in Section I.

Some emergency situations require immediate corrective action. These numbered steps are printed in boxes in the emergency procedures and should be done without the aid of the checklist.

WARNING/CAUTION/ADVISORY LIGHT SYSTEM

Annunciator lights are classified as WARNING, CAUTION, and ADVISORY. All except those associated with the Electronic Flight Instrument System (EFIS), autopilot, avionics, and engine fire warning/suppression systems are located in the annunciator panel. The abnormal and emergency procedures in this section are keyed, where applicable to these annunciators. Warning lights are generally red (except failure of both generators). The warning lights in the annunciator panel will cause the MASTER WARNING RESET light to flash. Failure of both generators (amber annunciators) is considered a red function and triggers the MASTER WARNING. Illumination of the LH/RH ENGINE FIRE light(s) will not trigger the MASTER WARNING light.

CAUTION lights are amber.

ADVISORY lights are white and do not trigger a master warning. When an advisory light is illuminated, pilot action may be required If an action is required it will be in the abnormal procedures in this section of the flight manual.

EMERGENCY PROCEDURES TABLE OF CONTENTS

EMERGENCY PROCEDURES
TABLE OF CONTENTS

EMERGENCY PROCEDURES

ENGINE FAILURE OR FIRE, OR MASTER WARNING DURING TAKEOFF

SPEED BELOW V_1 -TAKEOFF SHOULD BE ABORTED.

1. Brakes - AS REQUIRED.
2. Throttles - IDLE.
3. Speed Brakes - EXTEND.
4. Thrust Reverser - DEPLOY ON UNAFFECTED ENGINE.
5. Reverser Indicator Lights - CHECK ILLUMINATION of ARM, UNLOCK AND DEPLOY LIGHTS.
6. Thrust Reverser - REVERSE POWER ON THE UNAFFECTED ENGINE.

IF ENGINE FIRE

7. Accomplish Emergency Procedures, ENGINE FIRE.

IF ENGINE FAILURE

7. Accomplish Emergency Procedures, ENGINE FAILURE/PRECAUTIONARY SHUTDOWN.

NOTE

- To obtain maximum braking performance from the antiskid system, the pilot must apply continuous maximum effort (no modulation) to the brake pedals.
- The Takeoff Field Lengths assume that the pilot has maximum effort applied to the brakes at the scheduled V_1 speed during the aborted takeoff.

SPEED ABOVE V_1 - TAKEOFF SHOULD NORMALLY BE CONTINUED.

1. Rotate - V_R.
2. Landing Gear - UP (after positive rate-of-climb).
3. Climb - V_2 until 1500 feet AGL.

IF ENGINE FIRE

4. At or above 400 feet AGL, accomplish Emergency Procedures, ENGINE FIRE. (Continue with step 5 after complete).
5. Flaps - RETRACT (at 1500 feet AGL and V_2 + 10 KIAS, accelerate to V_{ENR}).
6. Throttle (operating engine) - SET Maximum Continuous N_1.

IF ENGINE FAILURE

4. At or above 400 feet AGL, accomplish Emergency Procedures, EMERGENCY RESTART - ONE ENGINE or Emergency Procedures, ENGINE FAILURE/PRECAUTIONARY SHUTDOWN. (Continue with step 5 after complete).
5. Flaps - RETRACT (at 1500 feet AGL and V_2 + 10 KIAS, accelerate to V_{ENR}).
6. Throttle (operating engine) - SET Maximum Continuous N_1.

ENGINE FAILURE/PRECAUTIONARY SHUTDOWN

1. Throttle (affected engine) - OFF.
2. Ignition (affected engine) - NORM.
3. Engine Synchronizer - OFF.
4. Generator (affected engine) - OFF.
5. Electrical Load - REDUCE as required.
6. Fuel Crossfeed - AS REQUIRED.
7. If Engine Anti-Ice On, Affected Engine ANTI-ICE - XFD.
8. If no fire, Firewall Shutoff - LEAVE OPEN and Fuel Boost Pump - ON.

NOTE

- If no fire hazard or engine damage exists, leave firewall shutoff OPEN and turn fuel boost pump ON to prevent damage to engine-driven fuel pump.
- If engine windmills with firewall shutoff CLOSED or with no indication of oil pressure, after landing refer to Engine Maintenance Manual.

9. Refer to Emergency Procedures, EMERGENCY RESTART - ONE ENGINE or Abnormal Procedures, SINGLE-ENGINE APPROACH and LANDING.

ENGINE FAILURE DURING COUPLED APPROACH

1. Power (operating engine) - INCREASE as required.
2. Autopilot and Yaw Damper - OFF.
3. Airspeed - V_{APP}.
4. Rudder Trim - TRIM toward operating engine as desired.
5. Flaps - TAKEOFF and APPROACH.

6. Throttle (affected engine) - OFF.
7. If engine fire, accomplish Emergency Procedures, ENGINE FIRE.
8. Passenger Advisory Lights - PASS SAFETY.
9. Passenger Seats - CHECK FULL UPRIGHT and OUTBOARD. FORWARD to clear exit doors.
10. Seats, Seat Belts and Shoulder Harnesses - SECURE.
11. Fuel Crossfeed - CHECK.
12. Ignition (operating engine) - ON.
13. Landing Gear - DOWN and LOCKED.
14. Antiskid - CHECK ON.
15. Annunciator Panel - CHECK.
16. Flaps - LAND (when landing assured).
17. Airspeed - V_{REF}.
18. Pressurization - CHECK ZERO DIFFERENTIAL.
19. Speed Brakes - RETRACTED PRIOR TO 50 FEET.

NOTE

Do not allow N_2 (turbine) RPM to be less than 52%.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) FAA Approved Airplane Flight Manual Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Operating Procedures, page 3-8, ENGINE FAILURE/PRECAUTIONARY SHUTDOWN, delete a step and a note.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) FAA Approved Airplane Flight Manual, adjacent to page 3-8.
Removal Instructions:	This temporary change must be removed and discarded once SB560-28-10 has been complied with.

In Section III, Operating Procedures, page 3-8, ENGINE FAILURE/PRECAUTIONARY SHUTDOWN, delete step 8 and the following note, and renumber step 9 as follows:

ENGINE FAILURE/PRECAUTIONARY SHUTDOWN

8. Refer to Emergency Procedures, EMERGENCY RESTART - ONE ENGINE or Abnormal Procedures, SINGLE-ENGINE APPROACH and LANDING.

APPROVED BY [signature]

for Ronald K. Rathgeber, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL MAR 4 2004

EMERGENCY RESTART - ONE ENGINE (Refer to Figure 3-1 for Airstart Envelope)

FOLLOWING SHUTDOWN - WITH STARTER ASSIST

1. Throttle - OFF.
2. Generator - GEN.
3. Firewall Shutoff - CHECK OPEN.
4. BOV Circuit Breaker (affected engine) - PULL and RESET.
5. Ignition - ON.
6. Start Button - PRESS momentarily.
7. Throttle - IDLE at 8% N_2 minimum.
8. Engine Instruments - MONITOR.
9. Ignition - NORM.

NOTE

A heading fail flag may appear momentarily (1-2 sec.) during a starter assisted airstart.

IF START DOES NOT OCCUR

10. Starter Disengage Button - PRESS.
11. Accomplish Emergency Procedures, ENGINE FAILURE/PRECAUTIONARY SHUTDOWN.

FOLLOWING SHUTDOWN - WINDMILLING WITH AIRSPEED ABOVE 200 KIAS.

1. Throttle - OFF.
2. Firewall Shutoff - CHECK OPEN.
3. BOV Circuit Breaker (affected engine) - PULL and RESET.
4. Ignition - ON.
5. Boost Pump - ON.
6. Throttle - IDLE.
7. Engine Instruments - MONITOR.
8. After engine stabilizes, Boost Pump and Ignition - NORM.
9. Generator - GEN.

NOTE

During high altitude windmilling starts below approximately 220 KIAS, fuel/air mixture instability may result in engine rumble and ITT above 500°C as engine accelerates between approximately 30% and 42% N_2. This is normal and not hazardous as long as ITT does not exceed limits.

EMERGENCY RESTART - TWO ENGINES (Refer to Figure 3-1 for Airstart Envelope)

1. Ignition - BOTH ON.
2. Boost Pumps - BOTH ON.
3. Throttles - IDLE.
4. If altitude allows - INCREASE AIRSPEED to 200 KIAS.

5. Firewall Shutoff - CHECK OPEN.
6. BOV Circuit Breaker (affected engines) - PULL and RESET.
7. All Anti-Ice Switches - OFF.
8. If no start in ten seconds: Either Start Button - PRESS momentarily.

AIRSTART ENVELOPE

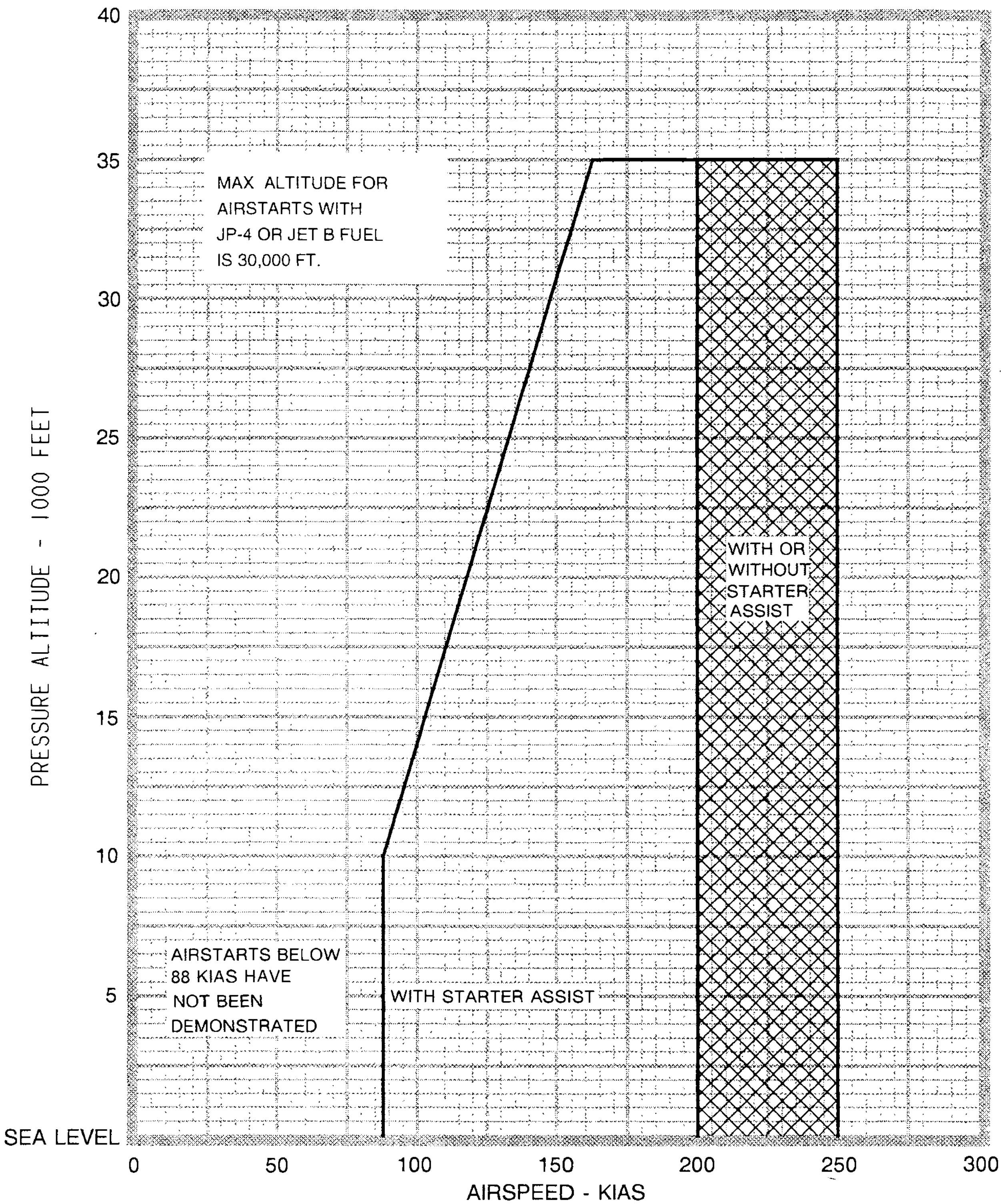


Figure 3-1

5684C6001

ENGINE FIRE (LH OR RH ENGINE FIRE WARNING LIGHT/SWITCH ILLUMINATED)

1. Throttle (affected engine) - IDLE.

IF LIGHT REMAINS ON

2. Engine Fire Switch - LIFT COVER and PUSH.
3. Either Illuminated Bottle Armed Light - PUSH.
4. Ignition - NORM.
5. Throttle (affected engine) - OFF.
6. Reduce Electrical Load - AS REQUIRED.
7. Boost Pump - OFF.
8. If engine Anti-ice ON, Affected Engine Anti-ice - XFD.
9. Land as soon as practical.

IF FIRE WARNING LIGHT REMAINS ON AFTER 30 SECONDS

10. Remaining Illuminated Bottle Armed Light - PUSH.
11. Land as soon as possible.

IF LIGHT GOES OUT AND SECONDARY INDICATIONS ARE NOT PRESENT

2. Land as soon as practical.

MAXIMUM GLIDE - EMERGENCY LANDING

1. Airspeed - 126 KIAS at 11,000 pounds. Increase speed approximately 3 KIAS per 500 pound increase in weight.

MAXIMUM GLIDE AIRSPEED

WEIGHT	11,000	12,000	13,000	14,000	15,000	16,000	16,300
KIAS	126	132	138	144	150	156	158

2. Flaps - UP.
3. Speed Brakes - RETRACT.
4. Landing Gear - UP.
5. Transponder - EMERGENCY.
6. ATC - ADVISE.
7. Passenger Advisory Switch - PASS SAFETY.
8. Shoulder Harness - SECURE.
9. Landing Gear, Speed Brakes and Flaps - AS REQUIRED (above 150 KIAS).

DITCHING

Ditching is not approved under FAR 25.801 and was not conducted during certification testing of the airplane. Should ditching be required, the following procedures are recommended:

PRELIMINARY

1. Bleed Air Selector - OFF.
2. Radio - MAYDAY.

(Continued Next Page)

DITCHING (Continued)

3. Transponder - EMERGENCY.
4. Locator Beacon - EMER.
5. ATC - ADVISE.
6. Passenger Advisory Lights - PASS SAFETY.
7. Prepare Passengers for Ditching.
8. Rate of Descent - 200/300 feet/minute.
9. Ditching Heading - Parallel to Major Swell System.

APPROACH

1. Landing Gear - UP.
2. Flaps - LAND.
3. Approach Speed - V_{REF}.

NOTE

Plan approach to parallel any uniform swell pattern and attempt to touch down along a wave crest or just behind it. If the surface wind is very strong or the water surface rough and irregular, ditch into the wind on the back side of a wave.

WATER CONTACT

1. Aircraft Pitch Attitude - Slightly higher than Normal Landing Attitude.
2. Reduce airspeed and rate of descent to a minimum, but do not stall the airplane.
3. Throttles - OFF just prior to water contact and contact water on a crest of a swell, parallel to the major swell.

AFTER WATER CONTACT

Under reasonable ditching conditions, the aircraft should remain afloat an adequate time to launch and board life rafts in an orderly manner.

WARNING

THE MAIN CABIN DOOR SHOULD REMAIN CLOSED AND EVACUATION MADE THROUGH THE EMERGENCY EXIT.

ELECTRICAL FIRE OR SMOKE

1. Oxygen Masks - DON and EMER.
2. Oxygen Microphone Switches - MIC OXY MASK.
3. Pressurization Source Selector - NORMAL.

CAUTION

WHETHER OR NOT SMOKE HAS DISSIPATED, IF IT CAN NOT BE VISIBLY CONFIRMED THAT ANY FIRE HAS BEEN EXTINGUISHED FOLLOWING FIRE SUPPRESSION AND/OR SMOKE EVACUATION PROCEDURE, LAND IMMEDIATELY AT THE NEAREST SUITABLE AIRPORT.

(Continued Next Page)

ELECTRICAL FIRE OR SMOKE (Continued)

KNOWN SOURCE

4. Faulty Circuit(s) - PULL CIRCUIT BREAKER(S) to isolate.

UNKNOWN SOURCE

4. Flood Lights - FULL BRIGHT.
5. Battery Switch - EMER.
6. Generators - OFF - With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment:

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Flight Display
DG 1	Pilot's and Copilot's Audio Panels	
Standby HSI		

The standby flight display will continue to operate on its own emergency battery pack. This battery pack also provides 5 volt emergency instrument lighting. Make sure that the cabin services (refreshment center, cabin lights) are OFF.

CAUTION

WHEN LANDING WITH EMERGENCY POWER (BATTERY SWITCH-EMER AND BOTH GENERATORS OFF), THE FOLLOWING ARE NOT AVAILABLE:

THE LANDING GEAR NORMAL OPERATION IS NOT AVAILABLE: THE LANDING GEAR MUST BE LOWERED USING THE BLOWDOWN SYSTEM AND THE LANDING GEAR WARNING LIGHTS WILL NOT ILLUMINATE.

THE FLAPS WILL NOT OPERATE. IF NOT PREVIOUSLY IN THE LANDING POSITION, A FLAPS INOPERATIVE LANDING MUST BE MADE.

THE ANTISKID/POWER BRAKE SYSTEM IS INOPERATIVE; ONLY THE EMERGENCY BRAKE SYSTEM IS AVAILABLE.

THE ENGINE ANTI-ICE VALVES WILL BE OPEN. REFER TO ANTI-ICE ON THRUST CHARTS.

THE RAM AIR TEMPERATURE GAGE IS INOPERATIVE, SO USE CAUTION WHEN APPLYING POWER (EXCEPT FOR GO-AROUND WHERE GROUND TEMPERATURES CAN BE USED).

ALL ENGINE INSTRUMENTS EXCEPT THE N_1 INDICATORS WILL BE INOPERATIVE.

7. Windshield Bleed Air Manual Valves - OFF.
8. DC Power RH Bus No. 1, 2 and 3 Circuit Breakers (on RH Panel) - PULL.
9. RH CB Panel Circuit Breaker (on LH Panel) - PULL.
10. AC Inverter No. 1 Circuit Breaker (on LH Panel) - PULL.
11. Land as soon as practical (within 30 minutes).

IF SEVERITY OF SMOKE WARRANTS

11. Initiate Emergency Procedures, SMOKE REMOVAL and/or EMERGENCY DESCENT. Land as soon as possible.

(Continued Next Page)

ELECTRICAL FIRE OR SMOKE (Continued)

WHEN LANDING ASSURED

12. LH Generator - GEN.
13. Landing Gear - DOWN.
14. Flaps - LAND.
15. Airspeed - V_{REF}.

IF SMOKE OR FIRE RESTARTS

16. LH Generator - OFF.
17. Landing - Plan for wheel brakes failure. Refer to Abnormal Procedures, WHEEL BRAKE FAILURE.

NOTE

Antiskid systems will be inoperative. Power brakes will be available until accumulator discharges. Multiply landing distance by 1.3. Be prepared to use the emergency brake system.

BATTERY OVERHEAT (BATT O'TEMP WARNING LIGHT ON AND MASTER WARNING)

1. Amperage - NOTE.
2. Battery Switch - EMER.
3. Amperage - NOTE DECREASE.
4. If battery voltage is one volt less than generator voltage in 30 seconds to 2 minutes, monitor battery overheat annunciator for possible change.

IF VOLT/AMP DECREASE

5. Battery Switch - OFF (voltmeter will be inoperative).

IF BATTERY O'TEMP LIGHT GOES OUT

6. Battery Switch - BATT.

IF NO AMP DECREASE OR BATTERY O'TEMP LIGHT FLASHES

5. Flood Lights - FULL BRIGHT.
6. Battery Switch - EMER.
7. Generators - OFF. The BATT O'TEMP light will extinguish immediately when the generators are turned off if the battery relay is not stuck. With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment.

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Flight Display
DG 1	Pilot's and Copilot's Audio Panels	
Standby HSI		

(Continued Next Page)

ELECTRICAL FIRE OR SMOKE (Continued)

KNOWN SOURCE

4. Faulty Circuit(s) - PULL CIRCUIT BREAKER(S) to isolate.

UNKNOWN SOURCE

4. Flood Lights - FULL BRIGHT.
5. Battery Switch - EMER.
6. Generators - OFF - With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment:

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Altitude/Airspeed Indicator Vibrator
DG 1	Pilot's and Copilot's Audio Panels	
Standby HSI		

The standby attitude indicator will continue to operate on its own emergency battery pack. This battery pack also provides 5 volt emergency instrument lighting. Make sure that the cabin services (refreshment center, cabin lights) are OFF.

CAUTION

WHEN LANDING WITH EMERGENCY POWER (BATTERY SWITCH-EMER AND BOTH GENERATORS OFF), THE FOLLOWING ARE NOT AVAILABLE:

THE LANDING GEAR NORMAL OPERATION IS NOT AVAILABLE: THE LANDING GEAR MUST BE LOWERED USING THE BLOWDOWN SYSTEM AND THE LANDING GEAR WARNING LIGHTS WILL NOT ILLUMINATE.

THE FLAPS WILL NOT OPERATE. IF NOT PREVIOUSLY IN THE LANDING POSITION, A FLAPS INOPERATIVE LANDING MUST BE MADE.

THE ANTISKID/POWER BRAKE SYSTEM IS INOPERATIVE; ONLY THE EMERGENCY BRAKE SYSTEM IS AVAILABLE.

THE ENGINE ANTI-ICE VALVES WILL BE OPEN. REFER TO ANTI-ICE ON THRUST CHARTS.

THE RAM AIR TEMPERATURE GAGE IS INOPERATIVE, SO USE CAUTION WHEN APPLYING POWER (EXCEPT FOR GO-AROUND WHERE GROUND TEMPERATURES CAN BE USED).

ALL ENGINE INSTRUMENTS EXCEPT THE N_1 INDICATORS WILL BE INOPERATIVE.

7. Windshield Bleed Air Manual Valves - OFF.
8. DC Power RH Bus No. 1, 2 and 3 Circuit Breakers (on RH Panel) - PULL.
9. RH CB Panel Circuit Breaker (on LH Panel) - PULL.
10. AC Inverter No. 1 Circuit Breaker (on LH Panel) - PULL.
11. Land as soon as practical (within 30 minutes).

IF SEVERITY OF SMOKE WARRANTS

11. Initiate Emergency Procedures, SMOKE REMOVAL and/or EMERGENCY DESCENT. Land as soon as possible.

(Continued Next Page)

ELECTRICAL FIRE OR SMOKE (Continued)

WHEN LANDING ASSURED

12. LH Generator - GEN.
13. Landing Gear - DOWN.
14. Flaps - LAND.
15. Airspeed - V_{REF}.

IF SMOKE OR FIRE RESTARTS

16. LH Generator - OFF.
17. Landing - Plan for wheel brakes failure. Refer to Abnormal Procedures, WHEEL BRAKE FAILURE.

NOTE

Antiskid systems will be inoperative. Power brakes will be available until accumulator discharges. Multiply landing distance by 1.3. Be prepared to use the emergency brake system.

BATTERY OVERHEAT (BATT O'TEMP WARNING LIGHT ON AND MASTER WARNING)

1. Amperage - NOTE.
2. Battery Switch - EMER.
3. Amperage - NOTE DECREASE.
4. If battery voltage is one volt less than generator voltage in 30 seconds to 2 minutes, monitor battery overheat annunciator for possible change.

IF VOLT/AMP DECREASE

5. Battery Switch - OFF (voltmeter will be inoperative).

IF BATTERY O'TEMP LIGHT GOES OUT

6. Battery Switch - BATT.

IF NO AMP DECREASE OR BATTERY O'TEMP LIGHT FLASHES

5. Flood Lights - FULL BRIGHT.
6. Battery Switch - EMER.
7. Generators - OFF. The BATT O'TEMP light will extinguish immediately when the generators are turned off if the battery relay is not stuck. With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment.

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Altitude/Airspeed Indicator Vibrator
DG 1	Pilot's and Copilot's Audio Panels	
Standby HSI		

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BATTERY OVERHEAT (BATT O'TEMP WARNING LIGHT ON AND MASTER WARNING) (Continued)

The standby flight display will continue to operate on its own emergency battery pack. This battery pack also provides 5 volt emergency instrument lighting. Make sure that the cabin services (refreshment center, cabin lights) are OFF.

CAUTION

WHEN LANDING WITH EMERGENCY POWER (BATTERY SWITCH-EMER AND BOTH GENERATORS OFF), THE FOLLOWING ARE NOT AVAILABLE:

THE LANDING GEAR NORMAL OPERATION IS NOT AVAILABLE: THE LANDING GEAR MUST BE LOWERED USING THE BLOWDOWN SYSTEM AND THE LANDING GEAR WARNING LIGHTS WILL NOT ILLUMINATE.

THE FLAPS WILL NOT OPERATE. IF NOT PREVIOUSLY IN THE LANDING POSITION, A FLAPS INOPERATIVE LANDING MUST BE MADE.

THE ANTISKID/POWER BRAKE SYSTEM IS INOPERATIVE; ONLY THE EMERGENCY BRAKE SYSTEM IS AVAILABLE.

THE ENGINE ANTI-ICE VALVES WILL BE OPEN. REFER TO ANTI-ICE ON THRUST CHARTS.

THE RAM AIR TEMPERATURE GAGE IS INOPERATIVE, SO USE CAUTION WHEN APPLYING POWER (EXCEPT FOR GO-AROUND WHERE GROUND TEMPERATURES CAN BE USED).

ALL ENGINE INSTRUMENTS EXCEPT THE N_1 INDICATORS WILL BE INOPERATIVE.

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BATTERY OVERHEAT (BATT O'TEMP WARNING LIGHT ON AND MASTER WARNING) (Continued)

IF NORMAL DC POWER IS LOST (BATTERY RELAY NOT STUCK)

8. Generators - GEN (BATT O'TEMP light will come back on until battery cools).
9. Battery Switch - OFF.

CAUTION

AFTER LANDING, REFER TO AIRPLANE MAINTENANCE MANUAL FOR PROPER MAINTENANCE PROCEDURES, AS DAMAGE TO THE BATTERY MAY HAVE OCCURRED.

10. Land as soon as practical.

IF NO DC POWER LOST (BATTERY RELAY STUCK)

8. Windshield Bleed Air Manual Valves - OFF.
9. DC Power LH and RH BUS NO. 1, 2 and 3 Circuit Breakers - PULL.
10. Land as soon as practical (within 30 minutes).

WHEN LANDING ASSURED

11. DC Power LH and RH Bus Circuit Breakers - RESET.
12. Landing Gear - DOWN.
13. Flaps - LAND.
14. Airspeed - V_{REF}.

CAUTION

AFTER LANDING, REFER TO AIRPLANE MAINTENANCE MANUAL FOR PROPER MAINTENANCE PROCEDURES, AS DAMAGE TO THE BATTERY MAY HAVE OCCURRED.

BATTERY OVERHEAT (BATT O'TEMP WARNING LIGHT ON AND MASTER WARNING) (Continued)

The standby attitude indicator will continue to operate on its own emergency battery pack. This battery pack also provides 5 volt emergency instrument lighting. Make sure that the cabin services (refreshment center, cabin lights) are OFF.

CAUTION

WHEN LANDING WITH EMERGENCY POWER (BATTERY SWITCH-EMER AND BOTH GENERATORS OFF), THE FOLLOWING ARE NOT AVAILABLE:

THE LANDING GEAR NORMAL OPERATION IS NOT AVAILABLE: THE LANDING GEAR MUST BE LOWERED USING THE BLOWDOWN SYSTEM AND THE LANDING GEAR WARNING LIGHTS WILL NOT ILLUMINATE.

THE FLAPS WILL NOT OPERATE. IF NOT PREVIOUSLY IN THE LANDING POSITION, A FLAPS INOPERATIVE LANDING MUST BE MADE.

THE ANTISKID/POWER BRAKE SYSTEM IS INOPERATIVE; ONLY THE EMERGENCY BRAKE SYSTEM IS AVAILABLE.

THE ENGINE ANTI-ICE VALVES WILL BE OPEN. REFER TO ANTI-ICE ON THRUST CHARTS.

THE RAM AIR TEMPERATURE GAGE IS INOPERATIVE, SO USE CAUTION WHEN APPLYING POWER (EXCEPT FOR GO-AROUND WHERE GROUND TEMPERATURES CAN BE USED).

ALL ENGINE INSTRUMENTS EXCEPT THE N_1 INDICATORS WILL BE INOPERATIVE.

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BATTERY OVERHEAT (BATT O'TEMP WARNING LIGHT ON AND MASTER WARNING) (Continued)

IF NORMAL DC POWER IS LOST (BATTERY RELAY NOT STUCK)

8. Generators - GEN (BATT O'TEMP light will come back on until battery cools).
9. Battery Switch - OFF.

CAUTION

AFTER LANDING, REFER TO AIRPLANE MAINTENANCE MANUAL FOR PROPER MAINTENANCE PROCEDURES, AS DAMAGE TO THE BATTERY MAY HAVE OCCURRED.

10. Land as soon as practical.

IF NO DC POWER LOST (BATTERY RELAY STUCK)

8. Windshield Bleed Air Manual Valves - OFF.
9. DC Power LH and RH BUS NO. 1, 2 and 3 Circuit Breakers - PULL.
10. Land as soon as practical (within 30 minutes).

WHEN LANDING ASSURED

11. DC Power LH and RH Bus Circuit Breakers - RESET.
12. Landing Gear - DOWN.
13. Flaps - LAND.
14. Airspeed - V_{REF}.

CAUTION

AFTER LANDING, REFER TO AIRPLANE MAINTENANCE MANUAL FOR PROPER MAINTENANCE PROCEDURES, AS DAMAGE TO THE BATTERY MAY HAVE OCCURRED.

LOSS OF BOTH GENERATORS (LH AND RH GEN OFF LIGHTS AND MASTER WARNING)

1. Generators - RESET THEN GEN.

IF ONLY ONE GENERATOR COMES ON

2. Electrical Load - REDUCE as required.

IF NEITHER GENERATOR COMES ON

2. Floodlights - FULL BRIGHT.
3. Battery Switch - EMER. With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment:

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Flight Display
DG 1	Pilot's and Copilot's Audio Panels	
Standby HSI	Voltmeter	

The standby flight display will continue to operate on its own emergency battery pack. This battery pack also provides 5 volt emergency instrument lighting. Make sure that the cabin services (refreshment center, cabin lights) are OFF.

CAUTION

WHEN LANDING WITH EMERGENCY POWER (BATTERY SWITCH-EMER AND BOTH GENERATORS OFF), THE FOLLOWING ARE NOT AVAILABLE:

- THE LANDING GEAR NORMAL OPERATION IS NOT AVAILABLE: THE LANDING GEAR MUST BE LOWERED USING THE BLOWDOWN SYSTEM AND THE LANDING GEAR WARNING LIGHTS WILL NOT ILLUMINATE.
- THE FLAPS WILL NOT OPERATE. IF NOT PREVIOUSLY IN THE LANDING POSITION, A FLAPS INOPERATIVE LANDING MUST BE MADE.
- THE ANTISKID/POWER BRAKE SYSTEM IS INOPERATIVE; ONLY THE EMERGENCY BRAKE SYSTEM IS AVAILABLE.
- THE ENGINE ANTI-ICE VALVES WILL BE OPEN. REFER TO ANTI-ICE ON THRUST CHARTS.
- THE RAM AIR TEMPERATURE GAGE IS INOPERATIVE, SO USE CAUTION WHEN APPLYING POWER (EXCEPT FOR GO-AROUND WHERE GROUND TEMPERATURES CAN BE USED).
- ALL ENGINE INSTRUMENTS EXCEPT THE N1 INDICATORS WILL BE INOPERATIVE.

4. Windshield Bleed Air Manual Valves - OFF or MINIMUM for clear vision through windshield.
5. Land as soon as practical (within 30 minutes).

WHEN LANDING ASSURED

6. Battery Switch - BATT.

AC POWER FAILURE (BOTH INVERTER FAIL 1 AND 2, AC FAIL, AND MASTER WARNING LIGHTS ON) DUAL INVERTER FAILURE

1. INV 1/INV 2 Switch - NORM.
2. Inverter Circuit Breakers (AC Inverter No. 1 on LH panel and AC Inverter No. 2 on RH Panel) - CHECK and RESET.

IF ONE OR BOTH INVERTERS RESET

3. INV 1/INV 2 Switch - SELECT Operating Inverter.
4. Land as soon as practical.

IF BOTH INVERTERS WILL NOT RESET

3. AC Inverter No.1 Circuit Breaker (LH Panel) - PULL
4. INVTR FAIL 2 Annunciator - CHECK (No annunciation indicates recovery of Inverter 2)

NOTE

If Inverter 2 recovers, do not reset inverter No. 1 breaker.

IF INVTR FAIL 2 ANNUNCIATOR REMAINS ILLUMINATED

5. AC Inverter No. 1 Circuit Breaker (LH Panel) - RESET
6. AC Inverter No. 2 Circuit Breaker (RH Panel) - PULL
7. INVTR FAIL 1 Annunciator - CHECK (No annunciation indicates recovery of Inverter 1)

NOTE

If Inverter 1 recovers, do not reset inverter No. 2 breaker.

IF INVERTER 1 OR 2 RECOVERS (INVTR FAIL 1 OR 2 ANNUNCIATOR EXTINGUISHED)

8. INV 1/INV 2 Switch - SELECT Operating Inverter
9. Land as soon as practical.

IF BOTH INVERTERS REMAIN FAILED

10. Battery Switch - EMER.

NOTE

If the inverters will not come back on line after the circuit breakers have been reset, complete the flight by using the standby flight instruments. Placing the battery switch to EMER will provide AC power from the static inverter in DG1 to power the standby compass system and NAV 1.

The Honeywell EFIS system (PFDs and MFD) will be inoperative with electrical system failure. With the battery switch in EMER, NAV 1 and compass information will be displayed on the Standby HSI. Refer to the standby attitude gyro and standby altimeter/airspeed indicator for attitude, altitude, and airspeed information.

11. Land as soon as practical (within 30 minutes).

LOSS OF BOTH GENERATORS (LH AND RH GEN OFF LIGHTS AND MASTER WARNING)

1. Generators - RESET THEN GEN.

IF ONLY ONE GENERATOR COMES ON

2. Electrical Load - REDUCE as required.

IF NEITHER GENERATOR COMES ON

2. Floodlights - FULL BRIGHT.
3. Battery Switch - EMER. With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment:

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Flight Display
DG 1	Pilot's and Copilot's Audio Panels	
Standby HSI	Voltmeter	

The standby flight display will continue to operate on its own emergency battery pack. This battery pack also provides 5 volt emergency instrument lighting. Make sure that the cabin services (refreshment center, cabin lights) are OFF.

CAUTION

WHEN LANDING WITH EMERGENCY POWER (BATTERY SWITCH-EMER AND BOTH GENERATORS OFF), THE FOLLOWING ARE NOT AVAILABLE:

- THE LANDING GEAR NORMAL OPERATION IS NOT AVAILABLE: THE LANDING GEAR MUST BE LOWERED USING THE BLOWDOWN SYSTEM AND THE LANDING GEAR WARNING LIGHTS WILL NOT ILLUMINATE.
- THE FLAPS WILL NOT OPERATE. IF NOT PREVIOUSLY IN THE LANDING POSITION, A FLAPS INOPERATIVE LANDING MUST BE MADE.
- THE ANTISKID/POWER BRAKE SYSTEM IS INOPERATIVE; ONLY THE EMERGENCY BRAKE SYSTEM IS AVAILABLE.
- THE ENGINE ANTI-ICE VALVES WILL BE OPEN. REFER TO ANTI-ICE ON THRUST CHARTS.
- THE RAM AIR TEMPERATURE GAGE IS INOPERATIVE, SO USE CAUTION WHEN APPLYING POWER (EXCEPT FOR GO-AROUND WHERE GROUND TEMPERATURES CAN BE USED).
- ALL ENGINE INSTRUMENTS EXCEPT THE N1 INDICATORS WILL BE INOPERATIVE.

4. Windshield Bleed Air Manual Valves - OFF or MINIMUM for clear vision through windshield.
5. Land as soon as practical (within 30 minutes).

WHEN LANDING ASSURED

6. Battery Switch - BATT.

AC POWER FAILURE (BOTH INVERTER FAIL 1 AND 2, AC FAIL, AND MASTER WARNING LIGHTS ON) DUAL INVERTER FAILURE

1. Inverter Circuit Breakers (AC Inverter No. 1 on LH panel and AC Inverter No. 2 on RH Panel) - CHECK and RESET.

IF ONE OR BOTH INVERTERS RESET

2. Land as soon as practical.

IF BOTH INVERTERS WILL NOT RESET

3. AC Inverter No.1 Circuit Breaker (LH Panel) - PULL
4. INVTR FAIL 2 Annunciator - CHECK (No annunciation indicates recovery of Inverter 2)

NOTE

If Inverter 2 recovers, do not reset inverter No. 1 breaker.

IF INVTR FAIL 2 ANNUNCIATOR REMAINS ILLUMINATED

5. AC Inverter No. 1 Circuit Breaker (LH Panel) - RESET
6. AC Inverter No. 2 Circuit Breaker (RH Panel) - PULL
7. INVTR FAIL 1 Annunciator - CHECK (No annunciation indicates recovery of Inverter 1)

NOTE

If Inverter 1 recovers, do not reset inverter No. 2 breaker.

IF INVERTER 1 OR 2 RECOVERS (INVTR FAIL 1 OR 2 ANNUNCIATOR EXTINGUISHED)

8. Land as soon as practical.

IF BOTH INVERTERS REMAIN FAILED

9. Battery Switch - EMER.

NOTE

If the inverters will not come back on line after the circuit breakers have been reset, complete the flight by using the standby flight instruments. Placing the battery switch to EMER will provide AC power from the static inverter in DG1 to power the standby compass system and NAV 1.

The Honeywell EFIS system (PFDs and MFD) will be inoperative with electrical system failure. With the battery switch in EMER, NAV 1 and compass information will be displayed on the Standby HSI. Refer to the standby attitude gyro and standby altimeter/airspeed indicator for attitude, altitude, and airspeed information.

10. Land as soon as practical (within 30 minutes).

LOSS OF BOTH GENERATORS (LH AND RH GEN OFF LIGHTS AND MASTER WARNING)

1. Generators - RESET THEN GEN.

IF ONLY ONE GENERATOR COMES ON

2. Electrical Load - REDUCE as required.

IF NEITHER GENERATOR COMES ON

2. Floodlights - FULL BRIGHT.
3. Battery Switch - EMER. With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment:

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Airspeed Indicator/Altimeter
DG 1	Pilot's and Copilot's Audio Panels	Vibrator
Standby HSI	Voltmeter	

The standby attitude indicator will continue to operate on its own emergency battery pack. This battery pack also provides 5 volt emergency instrument lighting. Make sure that the cabin services (refreshment center, cabin lights) are OFF.

CAUTION

WHEN LANDING WITH EMERGENCY POWER (BATTERY SWITCH-EMER AND BOTH GENERATORS OFF), THE FOLLOWING ARE NOT AVAILABLE:

- THE LANDING GEAR NORMAL OPERATION IS NOT AVAILABLE: THE LANDING GEAR MUST BE LOWERED USING THE BLOWDOWN SYSTEM AND THE LANDING GEAR WARNING LIGHTS WILL NOT ILLUMINATE.
- THE FLAPS WILL NOT OPERATE. IF NOT PREVIOUSLY IN THE LANDING POSITION, A FLAPS INOPERATIVE LANDING MUST BE MADE.
- THE ANTISKID/POWER BRAKE SYSTEM IS INOPERATIVE; ONLY THE EMERGENCY BRAKE SYSTEM IS AVAILABLE.
- THE ENGINE ANTI-ICE VALVES WILL BE OPEN. REFER TO ANTI-ICE ON THRUST CHARTS.
- THE RAM AIR TEMPERATURE GAGE IS INOPERATIVE, SO USE CAUTION WHEN APPLYING POWER (EXCEPT FOR GO-AROUND WHERE GROUND TEMPERATURES CAN BE USED).
- ALL ENGINE INSTRUMENTS EXCEPT THE N1 INDICATORS WILL BE INOPERATIVE.

4. Windshield Bleed Air Manual Valves - OFF or MINIMUM for clear vision through windshield.
5. Land as soon as practical (within 30 minutes).

WHEN LANDING ASSURED

6. Battery Switch - BATT.

AC POWER FAILURE (BOTH INVERTER FAIL 1 AND 2, AC FAIL, AND MASTER WARNING LIGHTS ON) DUAL INVERTER FAILURE

1. INV 1/INV 2 Switch - NORM.
2. Inverter Circuit Breakers (AC Inverter No. 1 on LH panel and AC Inverter No. 2 on RH Panel) - CHECK and RESET.

IF ONE OR BOTH INVERTERS RESET

3. INV 1/INV 2 Switch - SELECT Operating Inverter.
4. Land as soon as practical.

IF BOTH INVERTERS WILL NOT RESET

3. AC Inverter No.1 Circuit Breaker (LH Panel) - PULL
4. INVTR FAIL 2 Annunciator - CHECK (No annunciation indicates recovery of Inverter 2)

NOTE

If Inverter 2 recovers, do not reset inverter No. 1 breaker.

IF INVTR FAIL 2 ANNUNCIATOR REMAINS ILLUMINATED

5. AC Inverter No. 1 Circuit Breaker (LH Panel) - RESET
6. AC Inverter No. 2 Circuit Breaker (RH Panel) - PULL
7. INVTR FAIL 1 Annunciator - CHECK (No annunciation indicates recovery of Inverter 1)

NOTE

If Inverter 1 recovers, do not reset inverter No. 2 breaker.

IF INVERTER 1 OR 2 RECOVERS (INVTR FAIL 1 OR 2 ANNUNCIATOR EXTINGUISHED)

8. INV 1/INV 2 Switch - SELECT Operating Inverter
9. Land as soon as practical.

IF BOTH INVERTERS REMAIN FAILED

10. Battery Switch - EMER.

NOTE

If the inverters will not come back on line after the circuit breakers have been reset, complete the flight by using the standby flight instruments. Placing the battery switch to EMER will provide AC power from the static inverter in DG1 to power the standby compass system and NAV 1.

The Honeywell EFIS system (PFDs and MFD) will be inoperative with electrical system failure. With the battery switch in EMER, NAV 1 and compass information will be displayed on the Standby HSI. Refer to the standby attitude gyro and standby altimeter/airspeed indicator for attitude, altitude, and airspeed information.

11. Land as soon as practical (within 30 minutes).

LOSS OF BOTH GENERATORS (LH AND RH GEN OFF LIGHTS AND MASTER WARNING)

1. Generators - RESET THEN GEN.

IF ONLY ONE GENERATOR COMES ON

2. Electrical Load - REDUCE as required.

IF NEITHER GENERATOR COMES ON

2. Floodlights - FULL BRIGHT.
3. Battery Switch - EMER. With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment:

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Airspeed Indicator/Altimeter
DG 1	Pilot's and Copilot's Audio Panels	Vibrator
Standby HSI	Voltmeter	

The standby attitude indicator will continue to operate on its own emergency battery pack. This battery pack also provides 5 volt emergency instrument lighting. Make sure that the cabin services (refreshment center, cabin lights) are OFF.

CAUTION

WHEN LANDING WITH EMERGENCY POWER (BATTERY SWITCH-EMER AND BOTH GENERATORS OFF), THE FOLLOWING ARE NOT AVAILABLE:

- THE LANDING GEAR NORMAL OPERATION IS NOT AVAILABLE: THE LANDING GEAR MUST BE LOWERED USING THE BLOWDOWN SYSTEM AND THE LANDING GEAR WARNING LIGHTS WILL NOT ILLUMINATE.
- THE FLAPS WILL NOT OPERATE. IF NOT PREVIOUSLY IN THE LANDING POSITION, A FLAPS INOPERATIVE LANDING MUST BE MADE.
- THE ANTISKID/POWER BRAKE SYSTEM IS INOPERATIVE; ONLY THE EMERGENCY BRAKE SYSTEM IS AVAILABLE.
- THE ENGINE ANTI-ICE VALVES WILL BE OPEN. REFER TO ANTI-ICE ON THRUST CHARTS.
- THE RAM AIR TEMPERATURE GAGE IS INOPERATIVE, SO USE CAUTION WHEN APPLYING POWER (EXCEPT FOR GO-AROUND WHERE GROUND TEMPERATURES CAN BE USED).
- ALL ENGINE INSTRUMENTS EXCEPT THE N1 INDICATORS WILL BE INOPERATIVE.

4. Windshield Bleed Air Manual Valves - OFF or MINIMUM for clear vision through windshield.
5. Land as soon as practical (within 30 minutes).

WHEN LANDING ASSURED

6. Battery Switch - BATT.

AC POWER FAILURE (BOTH INVERTER FAIL 1 AND 2, AC FAIL, AND MASTER WARNING LIGHTS ON) DUAL INVERTER FAILURE

1. Inverter Circuit Breakers (AC Inverter No. 1 on LH panel and AC Inverter No. 2 on RH Panel) - CHECK and RESET.

IF ONE OR BOTH INVERTERS RESET

2. Land as soon as practical.

IF BOTH INVERTERS WILL NOT RESET

3. AC Inverter No.1 Circuit Breaker (LH Panel) - PULL
4. INVTR FAIL 2 Annunciator - CHECK (No annunciation indicates recovery of Inverter 2)

NOTE

If Inverter 2 recovers, do not reset inverter No. 1 breaker.

IF INVTR FAIL 2 ANNUNCIATOR REMAINS ILLUMINATED

5. AC Inverter No. 1 Circuit Breaker (LH Panel) - RESET
6. AC Inverter No. 2 Circuit Breaker (RH Panel) - PULL
7. INVTR FAIL 1 Annunciator - CHECK (No annunciation indicates recovery of Inverter 1)

NOTE

If Inverter 1 recovers, do not reset inverter No. 2 breaker.

IF INVERTER 1 OR 2 RECOVERS (INVTR FAIL 1 OR 2 ANNUNCIATOR EXTINGUISHED)

8. Land as soon as practical.

IF BOTH INVERTERS REMAIN FAILED

9. Battery Switch - EMER.

NOTE

If the inverters will not come back on line after the circuit breakers have been reset, complete the flight by using the standby flight instruments. Placing the battery switch to EMER will provide AC power from the static inverter in DG1 to power the standby compass system and NAV 1.

The Honeywell EFIS system (PFDs and MFD) will be inoperative with electrical system failure. With the battery switch in EMER, NAV 1 and compass information will be displayed on the Standby HSI. Refer to the standby attitude gyro and standby altimeter/airspeed indicator for attitude, altitude, and airspeed information.

10. Land as soon as practical (within 30 minutes).

AC POWER AND/OR DISTRIBUTION FAILURE (AC FAIL LIGHT ON AFTER MASTER WARNING HAS BEEN RESET, INVERTER FAIL 1 AND 2 LIGHTS OUT)

1. Check the right sub-circuit breaker panel for disengaged AC BUS circuit breaker(s).

CAUTION

IF CIRCUIT BREAKER(S) IS DISENGAGED, OPERATE WITH LOSS OF BUS AS RE-ENGAGEMENT MAY RESULT IN FURTHER DAMAGE TO THE ELECTRICAL SYSTEM.

NOTE

Depending on which bus(ses) has been lost, the following equipment will be lost:

a.	26 VAC Bus 1	Yaw Rate Gyro and TCAS, DG1
b.	115 VAC Bus 1	VG1
c.	26 VAC Bus 2	Radar, DG2
d.	115 VAC Bus 2	VG2

In addition, if any of the AC Busses are lost, neither autopilot nor Flight Director can be used.

PFD/MFD RED GUN FAILURE

The failure of a red gun in an electronic display indicator results in the following presentations:

PFD - Sky turns from dark blue to a dull dark blue.
Ground turns from brown to green hue
Compass rose turns from white to blue.

1. Use display with caution - MONITOR remaining displays for any red annunciators.

WARNING

FOLLOWING A FAILURE OF A RED GUN IN A DISPLAY UNIT, THE RED WARNING ANNUNCIATORS WILL NOT BE VISIBLE.

PFD ATTITUDE FAILURE - DUAL (ATT ANNUNCIATOR ILLUMINATED)

1. Airplane Attitude - CONTROL by reference to standby flight display in pilot's panel.

PFD HEADING FAILURE - DUAL (HDG ANNUNCIATOR ILLUMINATED)

1. Airplane Heading - CONTROL by reference to standby HSI in pilot's panel.

AIR DATA COMPUTER FAILURE - DUAL (ADC ANNUNCIATOR ILLUMINATED)

1. Airplane airspeed and altitude - MONITOR by reference to standby flight display in pilot's panel.

DISPLAY GUIDANCE COMPUTER FAILURE - DUAL (RED "X" OR BLANK PFD'S/MFD)

1. Airplane - CONTROL by reference to standby flight display in pilot's panel.

OVERPRESSURIZATION

1. Cabin Altitude Selector - SET to higher cabin altitude.
2. Rate Control - INCREASE.

IF STILL OVERPRESSURIZED

3. Pressurization Source Select - LH or RH; control cabin pressure with throttle.

IF UNABLE TO CONTROL

4. Oxygen Masks - DON and 100% OXYGEN.
5. Oxygen Control Valve - MANUAL DROP.
6. Passenger Oxygen - ENSURE passengers are receiving oxygen.
7. Oxygen Microphone Switches - MIC OXY MASK.
8. Passenger Advisory Light - PASS SAFETY.
9. Pressurization Source Selector - OFF.
10. Descend.

IF STILL OVERPRESSURIZED

11. Emergency Dump Switch - DUMP.
12. Refer to Abnormal Procedures, USE OF SUPPLEMENTAL OXYGEN.

CABIN DECOMPRESSION (CAB ALT 10000 FT LIGHT ON)

1. Oxygen Masks - DON and 100% OXYGEN.
2. Emergency Descent - AS REQUIRED.
3. Passenger Oxygen - ENSURE passengers are receiving oxygen.
4. Oxygen Microphone Switches - MIC OXY MASK.
5. Transponder - EMERGENCY.
6. Refer to Abnormal Procedures, USE OF SUPPLEMENTAL OXYGEN.

EMERGENCY DESCENT

1. Throttles - IDLE.
2. Speed Brakes - EXTEND.
3. Initiate Moderate Bank.
4. Airplane Pitch Attitude - APPROXIMATELY 25 DEGREES NOSE DOWN.
5. Passenger Advisory Lights - PASS SAFETY.
6. Maximum Airspeed - V_{MO}/M_{MO} (use reduced speed if structural damage has occurred).
7. Transponder - EMERGENCY.

IF DESCENT INTO ICING CONDITIONS IS REQUIRED

8. Anti-Ice/Deice - AS REQUIRED.
9. Throttles - AS REQUIRED maintain sufficient power for anti-icing (ENGINE ANTI-ICE annunciators extinguished).

ENVIRONMENTAL SYSTEM SMOKE OR ODOR

1. Oxygen Masks - DON and EMER.
2. Oxygen Microphone Switches - AS REQUIRED.
3. Cabin (OVHD) Fan - OFF.
4. Defog Fan - OFF.
5. Pressurization Source Selector - ISOLATE SOURCE by first selecting LH.

NOTE

Pressurization source selector must remain in each position long enough to allow adequate system purging to determine the source of smoke.

IF SMOKE CONTINUES

6. Pressurization Source Selector - RH (allow time for smoke to dissipate).

IF SMOKE STILL CONTINUES (AIR CYCLE MACHINE MAY BE LEAKING)

7. Pressurization Source Selector - EMER (control cabin pressure with LH throttle).

PFD/MFD RED GUN FAILURE

The failure of a red gun in an electronic display indicator results in the following presentations:

PFD - Sky turns from dark blue to a dull dark blue.
Ground turns from brown to green hue
Compass rose turns from white to blue.

1. Use display with caution - MONITOR remaining displays for any red annunciators.

WARNING

FOLLOWING A FAILURE OF A RED GUN IN A DISPLAY UNIT, THE RED WARNING ANNUNCIATORS WILL NOT BE VISIBLE.

PFD ATTITUDE FAILURE - DUAL (ATT ANNUNCIATOR ILLUMINATED)

1. Airplane Attitude - CONTROL by reference to standby attitude gyro in pilot's panel.

PFD HEADING FAILURE - DUAL (HDG ANNUNCIATOR ILLUMINATED)

1. Airplane Heading - CONTROL by reference to standby HSI in pilot's panel.

AIR DATA COMPUTER FAILURE - DUAL (ADC ANNUNCIATOR ILLUMINATED)

1. Airplane airspeed and altitude - MONITOR by reference to standby airspeed/altimeter in pilot's panel.

DISPLAY GUIDANCE COMPUTER FAILURE - DUAL (RED "X" OR BLANK PFD'S/MFD)

1. Airplane - CONTROL by reference to standby flight instruments in pilot's panel.

OVERPRESSURIZATION

1. Cabin Altitude Selector - SET to higher cabin altitude.
2. Rate Control - INCREASE.

IF STILL OVERPRESSURIZED

3. Pressurization Source Select - LH or RH; control cabin pressure with throttle.

IF UNABLE TO CONTROL

4. Oxygen Masks - DON and 100% OXYGEN.
5. Oxygen Control Valve - MANUAL DROP.
6. Passenger Oxygen - ENSURE passengers are receiving oxygen.
7. Oxygen Microphone Switches - MIC OXY MASK.
8. Passenger Advisory Light - PASS SAFETY.
9. Pressurization Source Selector - OFF.
10. Descend.

IF STILL OVERPRESSURIZED

11. Emergency Dump Switch - DUMP.
12. Refer to Abnormal Procedures, USE OF SUPPLEMENTAL OXYGEN.

CABIN DECOMPRESSION (CAB ALT 10000 FT LIGHT ON)

1. Oxygen Masks - DON and 100% OXYGEN.
2. Emergency Descent - AS REQUIRED.
3. Passenger Oxygen - ENSURE passengers are receiving oxygen.
4. Oxygen Microphone Switches - MIC OXY MASK.
5. Transponder - EMERGENCY.
6. Refer to Abnormal Procedures, USE OF SUPPLEMENTAL OXYGEN.

EMERGENCY DESCENT

1. Throttles - IDLE.
2. Speed Brakes - EXTEND.
3. Initiate Moderate Bank.
4. Airplane Pitch Attitude - APPROXIMATELY 25 DEGREES NOSE DOWN.
5. Passenger Advisory Lights - PASS SAFETY.
6. Maximum Airspeed - V_{MO}/M_{MO} (use reduced speed if structural damage has occurred).
7. Transponder - EMERGENCY.

IF DESCENT INTO ICING CONDITIONS IS REQUIRED

8. Anti-Ice/Deice - AS REQUIRED.
9. Throttles - AS REQUIRED maintain sufficient power for anti-icing (ENGINE ANTI-ICE annunciators extinguished).

ENVIRONMENTAL SYSTEM SMOKE OR ODOR

1. Oxygen Masks - DON and EMER.
2. Oxygen Microphone Switches - AS REQUIRED.
3. Cabin (OVHD) Fan - OFF.
4. Defog Fan - OFF.
5. Pressurization Source Selector - ISOLATE SOURCE by first selecting LH.

NOTE

Pressurization source selector must remain in each position long enough to allow adequate system purging to determine the source of smoke.

IF SMOKE CONTINUES

6. Pressurization Source Selector - RH (allow time for smoke to dissipate).

IF SMOKE STILL CONTINUES (AIR CYCLE MACHINE MAY BE LEAKING)

7. Pressurization Source Selector - EMER (control cabin pressure with LH throttle).

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Ultra FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2002.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Emergency Procedures, page 3-18, CABIN DECOMPRESSION (CAB ALT 10000 FT LIGHT ON), replace a procedure.
Filing Instructions:	Insert this temporary change in the Model 560 (560-0260 thru -0538) FAA Approved Airplane Flight Manual, adjacent to page 3-18.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the FAA Approved Airplane Flight Manual.

In Section III, Emergency Procedures, page 3-18, replace the CABIN DECOMPRESSION (CAB ALT 10000 FT LIGHT ON) procedure with the following:

CABIN DECOMPRESSION (CAB ALT 10,000 FT WARNING LIGHT ON)

1. Oxygen Masks - DON and 100% OXYGEN.4
2. Oxygen Microphone Switches - MIC OXY MASK.
3. Emergency Descent - AS REQUIRED.
4. Pressurization Source Selector - NORMAL.
5. Passenger Oxygen - ENSURE passengers are receiving oxygen (MANUAL DROP as required).
6. Transponder - EMERGENCY.

NOTE

- Headsets or hats worn by the crew should be removed prior to donning the oxygen masks.
- The passenger oxygen masks will deploy automatically when cabin altitude exceeds 13,500 feet ±600 feet.
- If a high altitude airport (field elevation greater than 8000 feet MSL) is selected on the cabin pressurization controller, the CAB ALT 10,000 FT warning light will illuminate at a cabin altitude of 10,000 feet ±350 feet.

IF NOT ARRESTED BY 14,000 FEET CABIN ALTITUDE

7. PRESS SOURCE Select Knob - EMER.
8. Control cabin temperature with LH throttle.
9. Emergency Descent - INITIATE. Refer to Emergency Procedures, EMERGENCY DESCENT.
10. Refer to Abnormal Procedures, USE OF SUPPLEMENTAL OXYGEN.
11. Below 10,000 feet MSL, consider PRESS SOURCE Select Knob - NORM.
12. Land as soon as practical.

(Continued Next Page)

CABIN DECOMPRESSION (CAB ALT 10,000 FT WARNING LIGHT ON)
(Continued)

IF ARRESTED BELOW 14,000 FEET CABIN ALTITUDE

7. Refer to Abnormal Procedures, USE OF SUPPLEMENTAL OXYGEN.
8. Land as soon as practical.

APPROVED BY DM Baker
for
Ronald K. Rathgeber, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 5/28/04

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Ultra FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2002.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Emergency Procedures, page 3-18, EMERGENCY DESCENT, replace a procedure.
Filing Instructions:	Insert this temporary change in the Model 560 (560-0260 thru -0538) FAA Approved Airplane Flight Manual, adjacent to page 3-18.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the FAA Approved Airplane Flight Manual.

In Section III, Emergency Procedures, page 3-18, replace the EMERGENCY DESCENT procedure with the following:

EMERGENCY DESCENT

1. AP TRIM DISC - PRESS and RELEASE.
2. Throttles - IDLE.
3. Speed Brakes - EXTEND.
4. Airplane Pitch Attitude - INITIALLY TARGET 25 DEGREES NOSE DOWN.
5. Airspeed - M_{MO}/V_{MO} (use reduced speed if structural damage has occurred).
6. Transponder - EMERGENCY.
7. Passenger Advisory Switch - PASS SAFETY.
8. ATC - ADVISE and obtain local altimeter setting.
9. Altitude - 10,000 feet MSL or Minimum Safe Altitude, whichever is higher.

NOTE

If terrain or other circumstances prevent a direct descent to 10,000 feet MSL, the descent to 10,000 feet MSL should be completed within 25 minutes of the initiation of the emergency descent.

IF DESCENT INTO ICING CONDITIONS IS REQUIRED

10. Anti-Ice/Deice - AS REQUIRED.
11. Throttles - AS REQUIRED, maintain sufficient thrust for anti-icing (engine ANTI-ICE lights extinguished).

APPROVED BY ____________
for
Ronald K. Rathgeber, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 5/28/04

SMOKE REMOVAL

NOTE

No action is normally required; however, if smoke is intense:

1. Oxygen Masks - DON and EMER.
2. Oxygen Control Valve - MANUAL DROP.
3. Cockpit Divider Door - OPEN.
4. Passenger Oxygen - ENSURE passengers are receiving oxygen.
5. Oxygen Microphone Switches - MIC OXY MASK.
6. Passenger Advisory Light - PASS SAFETY.
7. Cabin Altitude Selector - SET to higher cabin altitude.
8. Emergency Dump Switch - DUMP (cabin Altitude will not exceed approximately 14,000 feet).
9. Refer to Abnormal Procedures, USE OF SUPPLEMENTAL OXYGEN.

IF SMOKE PERSISTS OR IT CANNOT BE VERIFIED THAT THERE IS NO FIRE

10. Land as soon as possible.

CAUTION

WHETHER OR NOT SMOKE HAS DISSIPATED, IF IT CAN NOT BE VISIBLY CONFIRMED THAT ANY FIRE HAS BEEN EXTINGUISHED FOLLOWING FIRE SUPPRESSION AND/OR SMOKE EVACUATION PROCEDURE, LAND IMMEDIATELY AT THE NEAREST SUITABLE AIRPORT.

THRUST REVERSER INADVERTENT DEPLOYMENT DURING TAKEOFF

SPEED BELOW V_1 - TAKEOFF SHOULD BE ABORTED.

1. Brakes - AS REQUIRED.
2. Throttles - IDLE.
3. Speed Brakes - EXTEND.
4. Thrust Reversers - BOTH DEPLOY.
5. Reverser Indicator Lights - CHECK ILLUMINATION of ARM, UNLOCK and DEPLOY LIGHTS.
6. Thrust Reversers - REVERSE POWER ON BOTH ENGINES.

SPEED ABOVE V_1 - TAKEOFF SHOULD NORMALLY BE CONTINUED.

1. Emergency Stow Switch - EMER (affected engine).
2. After establishing a positive rate-of-climb, Landing Gear - RETRACT. Do not exceed 125 KIAS until thrust reverser stows.
3. At 400 feet, Flaps - RETRACT at V_2 +10 and accelerate. Do not exceed 200 KIAS after thrust reverser stows.
4. Land as soon as practical.

(Continued Next Page)

THRUST REVERSER INADVERTENT DEPLOYMENT DURING TAKEOFF
(Continued)

IF THRUST REVERSER WILL NOT STOW

5. Thrust Reverser Circuit Breaker - CHECK IN.
6. Throttle (affected engine) - CUTOFF.
7. Airspeed - Maintain 150 KIAS or below.
8. Refer to Abnormal Procedures, SINGLE-ENGINE APPROACH AND LANDING.

WARNING

CAPABILITY OF A GO-AROUND WITH A THRUST REVERSER DEPLOYED HAS NOT BEEN DEMONSTRATED.

THRUST REVERSER INADVERTENT INFLIGHT DEPLOYMENT

1. Control Wheel/Autopilot - GRIP/DISENGAGE (airplane will tend to pitch up and roll into the deployed reverser).
2. Emergency Stow Switch - EMER (affected engine).
3. Throttle (affected engine) - CHECK IDLE.
4. Airspeed - REDUCE TO 125 KIAS OR BELOW. AFTER THRUST REVERSER STOWS, DO NOT EXCEED 200 KIAS.
5. Reverser Indicator Lights - UNLOCK and DEPLOY LIGHT EXTINGUISHED.
   - ARM LIGHT ILLUMINATED.
6. Throttle (affected engine) - NORMAL OPERATION.
7. Land as soon as practical. Refer to Normal Procedures, BEFORE LANDING.

IF THRUST REVERSER WILL NOT STOW

8. Thrust Reverser Circuit Breakers (LH Panel) - CHECK IN.

IF THRUST REVERSER STILL WILL NOT STOW

9. Throttle (affected engine) - OFF.
10. Airspeed - MAINTAIN 150 KIAS OR BELOW.
11. Land as soon as practical.
12. Refer to Abnormal Procedures, SINGLE ENGINE APPROACH AND LANDING.

WARNING

CAPABILITY OF A GO-AROUND WITH A THRUST REVERSER DEPLOYED HAS NOT BEEN DEMONSTRATED.

THRUST REVERSER UNLOCK LIGHT ON IN FLIGHT

1. Emergency Stow Switch - EMER (affected engine).
2. Thrust Reverser Levers - CHECK THRUST REVERSER LEVERS AT STOWED (FULL FORWARD) POSITION.

IF LIGHT WILL NOT EXTINGUISH

3. Thrust Reverser Circuit Breaker - CHECK IN.
4. Maintain 200 KIAS or below.
5. Land as soon as practical.

THRUST REVERSER ARM LIGHT ON IN FLIGHT

1. Thrust Reverser Levers - CHECK STOWED (full forward).
2. Emergency Stow Switch - Verify NORM.

THRUST REVERSER ARM LIGHT ON INFLIGHT

IF LIGHT IS STILL ILLUMINATED

3. Airspeed - Maintain 200 KIAS or Below.
4. HYD PRESS ON light - CHECK.

IF HYD PRESS ON LIGHT IS ILLUMINATED (THRUST REVERSER ISOLATION VALVE IS OPEN)

5. Affected Thrust Reverser Circuit Breaker - PULL.
6. Land As Soon As Possible (affected thrust reverser will be inoperative).

IF HYD PRESS ON LIGHT IS NOT ILLUMINATED

5. Land as soon as practical.

NOTE

With a thrust reverser circuit breaker pulled, the emergency stow system of the opposite reverser is deactivated.

AUTOPILOT MALFUNCTION

1. Autopilot/Trim Disengage Switch - PRESS.

NOTE

The autopilot monitors normally detects failures and automatically disengages the autopilot.

NOTE

Maximum altitude losses during autopilot malfunction:

Cruise	400 Feet at 37,000 Feet.
Climb	0 Feet at 17,000 Feet.
ILS Approach	40 Feet. (Maximum deviation below glideslope during recovery from a failure at the critical fault point) Refer to Figure 3-2 for Glideslope Deviation Profile.

AUTOPILOT GLIDESLOPE DEVIATION PROFILE

CONDITIONS:

Airspeed - V_{REF}
Flaps - Land
Gear - Down
Corrective action initiated one second after fault recognition.
Pilot's hands on control wheel and power levers during the approach.

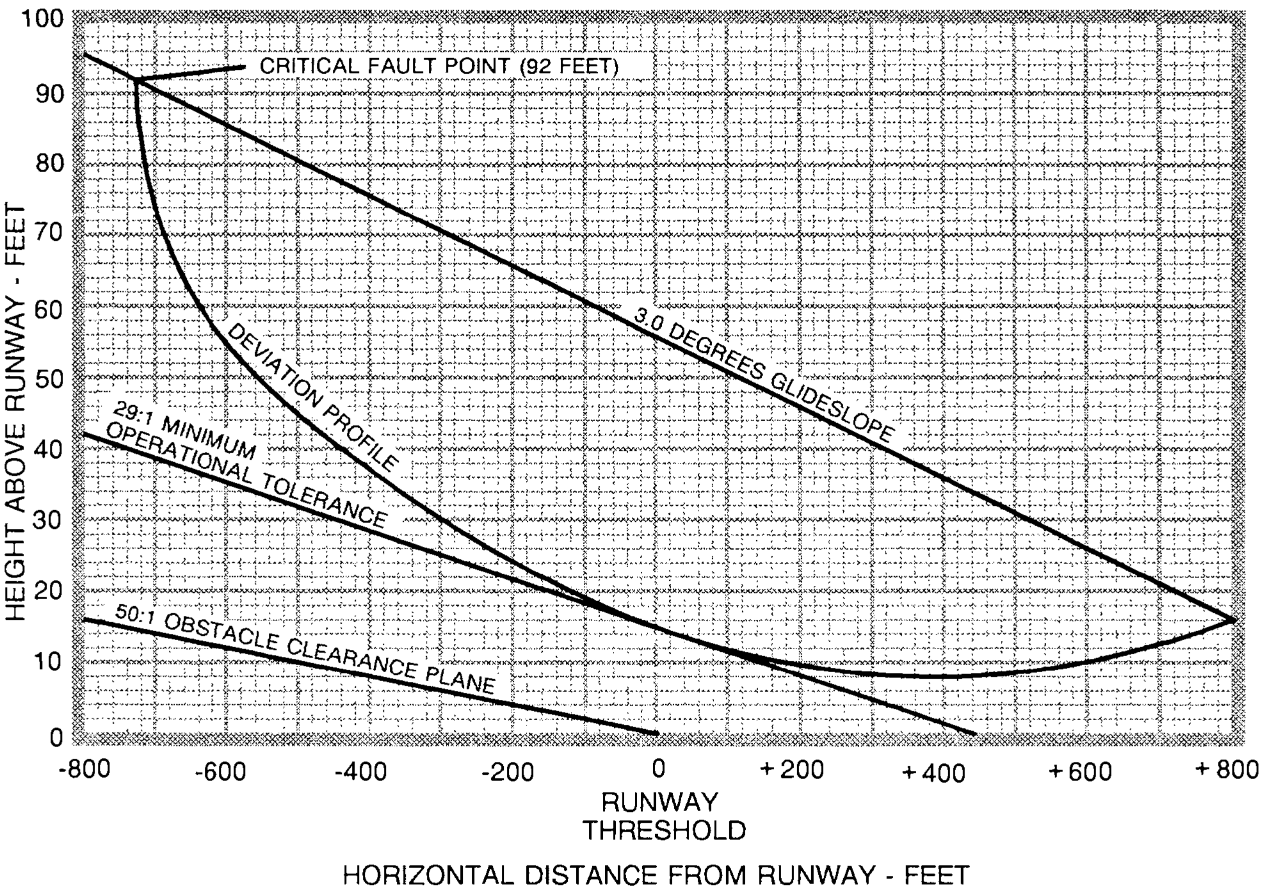

Figure 3-2

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TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru –0538.
Description of Change:	Section III, Operating Procedures, Emergency Procedures, add Inadvertent Stall (buffet/roll-off) information.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-23/3-24.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Emergency Procedures, on page 3-23/3-24, add the following Inadvertent Stall (buffet/roll-off) information after the EMERGENCY EVACUATION procedures:

INADVERTENT STALL (buffet/roll-off)

1. **Autopilot – DISCONNECT.**
2. **Pitch Attitude – REDUCE.**
3. **Roll Attitude – LEVEL.**
4. **Throttles – MAXIMUM THRUST.**

NOTE

Pitch attitude should be promptly reduced to at least 0 - 5° nose down. Prompt aileron input may be required to maintain wings level flight.

5. Airspeed – INCREASE.
6. Altitude – RETURN TO PREVIOUS ALTITUDE.
7. Throttles – AS REQUIRED.

APPROVED BY

fr Margaret Kline, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 8/31/07

EMERGENCY EVACUATION

1. Throttles - BOTH OFF.
2. LH/RH Engine Fire Switches - BOTH PRESS.
3. LH/RH Fire Bottle Armed Switches - BOTH PRESS (if fire suspected).
4. Battery Switch - OFF.
5. Airplane and Immediate Area - CHECK for BEST ESCAPE ROUTE.

IF THRU CABIN DOOR

6. Cabin Door - OPEN.
7. Move away from airplane.

IF THRU ESCAPE HATCH

6. Escape Hatch - REMOVE and THROW HATCH OUT of airplane.
7. Move away from airplane.

ABNORMAL PROCEDURES
TABLE OF CONTENTS

(Continued Next Page)

ABNORMAL PROCEDURES (Continued)

ABNORMAL PROCEDURES
TABLE OF CONTENTS

(Continued Next Page)

ABNORMAL PROCEDURES (Continued)

FLIGHT GUIDANCE

HYDRAULICS/BRAKES

ABNORMAL LANDING

MISCELLANEOUS

ABNORMAL PROCEDURES

ENGINE START MALFUNCTION (ENGINE DOES NOT LIGHT)

1. Throttle - OFF.
2. Starter Disengage - PRESS 15 seconds after throttle OFF.

ENGINE STARTER WILL NOT DISENGAGE (LH OR RH START BUTTON LIGHT ON AFTER ENGINE START)

1. Starter Disengage Button - PRESS.

IF STARTER DOES NOT DISENGAGE AND START BUTTON LIGHT REMAINS ILLUMINATED (START RELAY STUCK)

2. External Power - CHECK CLEAR (if applicable).
3. Battery Switch - OFF.
4. Generator Switches - OFF.
5. Battery Quick Disconnect Connector - DISCONNECT (located in tailcone).
6. Throttle(s) - OFF.

HIGH SUSTAINED ITT DURING GROUND SHUTDOWN

1. Throttle - CHECK OFF.
2. Start Button - PRESS momentarily.
3. Starter Disengage - PRESS after 15 seconds.

LOW OIL PRESSURE (OIL PRESS WARN LH OR RH LIGHT ON)

ABOVE 60 PSI

1. Land as soon as practical.

BETWEEN 40 AND 60 PSI

1. Throttle (affected engine) - REDUCE POWER.
2. Land as soon as practical.

BELOW 40 PSI

1. Throttle (affected engine) - OFF.
2. Accomplish Emergency Procedures, ENGINE FAILURE/PRECAUTIONARY SHUTDOWN.

LOW OIL PRESSURE (OIL PRESS WARN LH OR RH LIGHT OFF)

BETWEEN 40 AND 60 PSI

1. Throttle (affected engine) - REDUCE POWER.

BELOW 40 PSI

1. Land as soon as practical.

LOW FUEL PRESSURE (FUEL LOW PRESS LH OR RH LIGHT ON)

1. Fuel Boost - ON (check boost pump circuit breakers in).
2. Fuel Quantity - CHECK.
3. Fuel Crossfeed - IF REQUIRED.

LOW FUEL QUANTITY (FUEL LOW LEVEL LH OR RH LIGHT ON)

The illumination of this light serves notice to the pilot that a minimum of 185 ±15 pounds of fuel remains in either tank.

1. Fuel Boost - ON (check boost pump circuit breakers in).
2. Fuel Crossfeed - AS REQUIRED.
3. Land as soon as practical.

FUEL BOOST PUMP ON (FUEL BOOST ON LH OR RH LIGHT ON)

Indicates that the respective fuel boost pump was either automatically or manually turned on.

1. Fuel Boost Switch (affected pump) - ON; then NORM. CHECK for FUEL LOW PRESS LIGHT to illuminate and extinguish.

If affected FUEL LOW PRESS light does not illuminate, leave the fuel boost switch in NORM with pump running.

FUEL FILTER BYPASS (FUEL FLTR BYPASS LH OR RH LIGHT ON)

1. Land as soon as practical - Consider possibility of partial or total loss of both engines thrust.
2. Inspect filter after landing.

SINGLE GENERATOR FAILURE (GEN OFF LH OR RH LIGHT ON)

1. Electrical Load - DECREASE if required.
2. Air Conditioner - OFF or FAN.
3. Failed Generator - CHECK SWITCHES and CIRCUIT BREAKERS; RESET AS REQUIRED.

IF UNABLE TO RESET

4. Failed Generator - OFF.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) FAA Approved Airplane Flight Manual Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Operating Procedures, page 3-28, LOW FUEL QUANTITY (FUEL LOW LEVEL LH OR RH LIGHT ON), replace a procedure.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) FAA Approved Airplane Flight Manual, adjacent to page 3-28.
Removal Instructions:	This temporary change must be removed and discarded once SB560-28-10 has been complied with.

In Section III, Operating Procedures, page 3-28, replace the LOW FUEL QUANTITY (FUEL LOW LEVEL LH OR RH LIGHT ON) procedure with the following:

LOW FUEL QUANTITY (FUEL LOW LEVEL LH OR RH LIGHT ON)

The illumination of this light serves notice to the pilot that a minimum of 185 ±15 pounds of fuel remains in either tank.

1. Land as soon as practical.

APPROVED BY _______________
for Ronald K. Rathgeber, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL MAR 4 2004

SINGLE INVERTER FAILURE (INVERTER FAIL 1 OR 2, AC FAIL, AND MASTER WARNING ON)

Indicates detection of a fault or loss of power from affected inverter.

1. Inverter Circuit Breaker (AC INVERTER NO. 1 on LH Panel or AC INVERTER NO. 2 on RH Panel) - CHECK IN.
2. INV1/INV2 Switch - MOMENTARILY SELECT OPERATING INVERTER, THEN NORM.

IF AFFECTED INVERTER RESETS (FAULT HAS CLEARED)

3. Flight Guidance System - RESET MODES AS APPLICABLE.
4. Master Warning - RESET and continue flight.

IF AFFECTED INVERTER WILL NOT RESET

3. INV1/INV2 Switch - SELECT OPERATING INVERTER.
4. Flight Guidance System - RESET MODES AS APPLICABLE.
5. Master Warning - RESET.

NOTE

Operation of all alternating current powered avionics equipment will be sustained by the opposite inverter. The autopilot and flight director may disengage. They may be re-engaged to operate on the remaining inverter.

6. Continue or land at pilot's discretion.

IF REMAINING INVERTER FAILS DURING SWITCHING PROCESS

7. Refer to Emergency Procedures, AC POWER FAILURE.

BLEED AIR GROUND (BLD AIR GND LIGHT ON)

Light must be out before takeoff.

IN FLIGHT

1. Pressurization Source Selector Switch - NORM.

ENVIRONMENTAL SYSTEM AIR DUCT OVERHEAT (AIR DUCT O'HEAT LIGHT ON)

1. TEMP Circuit Breaker - RESET.
2. Auto Temperature Select - MANUAL.
3. Manual Hot/Manual Cold Switch - MANUAL COLD; hold in this position until overheat light goes out (30 seconds maximum).

NOTE

High altitude operation (above 31,000 feet) in MANUAL (cold mode) could result in the air cycle machine overtemp and shutdown. Refer to Abnormal Procedures, AUTOMATIC CABIN TEMPERATURE CONTROLLER INOPERATIVE.

IF LIGHT GOES OUT

4. Auto Temperature Select - AUTO (select a cooler temperature)

NOTE

If the AIR DUCT O'HEAT light illuminates again, select MANUAL on Auto Temperature Selector and Control Temperature with the MANUAL HOT/MANUAL COLD Switch.

(Continued Next Page)

ENVIRONMENTAL SYSTEM AIR DUCT OVERHEAT (AIR DUCT O'HEAT LIGHT ON) (Continued)

IF LIGHT DOES NOT GO OUT

4. Pressurization Source Selector - LH or RH; reduce power on selected engine, if necessary

AUTOMATIC CABIN TEMPERATURE CONTROLLER INOPERATIVE

1. Cabin Temperature Control - MANUAL.
2. MANUAL HOT/MANUAL COLD Switch - ENSURE NOT FULL COLD. Select full cold, at least 10 seconds then actuate at least 3 seconds toward HOT.

NOTE

Operation in manual mode, full cold, above 31,000 feet, particularly at low (climb) airspeed may result in air cycle machine overtemperature and shutdown. In the unlikely event that this should occur, refer to Abnormal Procedures, EMERGENCY PRESSURIZATION ON.

EMERGENCY PRESSURIZATION ON (AUTOMATIC ACTUATION) (EMERG PRESS ON LIGHT ON)

Indicates air cycle machine shutdown or failure.

1. NORM Pressurization Circuit Breaker - CHECK IN.
2. Temperature Control - ADJUST TO WARMER SETTING (may require manual mode).

NOTE

A time delay relay will lock the system into emergency pressurization if air cycle machine temperature remains too high for 12 seconds or more. If machine cools sufficiently in less than 12 seconds, the system will automatically return to the previously selected mode.

3. Pressurization Source Selector - EMER.

NOTE

Wait at least one minute after pressurization source selector has been positioned to EMER before making next selection.

4. Pressurization Source Selector - RH, LH or NORM.

IF EMERGENCY PRESSURIZATION REMAINS ON

5. Pressurization Source Selector - EMER.
6. Control cabin temperature with LH throttle.

SINGLE INVERTER FAILURE (INVERTER FAIL 1 OR 2 AND AC FAIL LIGHTS ON)

Indicates loss of power from affected inverter.

1. AC Inverter No. 1 and No. 2 Circuit Breakers - CHECK IN.
2. Master Warning - RESET and continue flight.

NOTE

Operation of all alternating current powered avionics equipment will be sustained by the opposite inverter. The flight director may disengage. It may be re-engaged to operate on the remaining inverter.

3. Continue or land at pilot's discretion.

BLEED AIR GROUND (BLD AIR GND LIGHT ON)

Light must be out before takeoff.

IN FLIGHT

1. Pressurization Source Selector Switch - NORM.

ENVIRONMENTAL SYSTEM AIR DUCT OVERHEAT (AIR DUCT O'HEAT LIGHT ON)

1. TEMP Circuit Breaker - RESET.
2. Auto Temperature Select - MANUAL.
3. Manual Hot/Manual Cold Switch - MANUAL COLD; hold in this position until overheat light goes out (30 seconds maximum).

NOTE

High altitude operation (above 31,000 feet) in MANUAL (cold mode) could result in the air cycle machine overtemp and shutdown. Refer to Abnormal Procedures, AUTOMATIC CABIN TEMPERATURE CONTROLLER INOPERATIVE.

IF LIGHT GOES OUT

4. Auto Temperature Select - AUTO (select a cooler temperature)

NOTE

If the AIR DUCT O'HEAT light illuminates again, select MANUAL on Auto Temperature Selector and Control Temperature with the MANUAL HOT/MANUAL COLD Switch.

(Continued Next Page)

ENVIRONMENTAL SYSTEM AIR DUCT OVERHEAT (AIR DUCT O'HEAT LIGHT ON) (Continued)

IF LIGHT DOES NOT GO OUT

4. Pressurization Source Selector - LH or RH; reduce power on selected engine, if necessary

AUTOMATIC CABIN TEMPERATURE CONTROLLER INOPERATIVE

1. Cabin Temperature Control - MANUAL.
2. MANUAL HOT/MANUAL COLD Switch - ENSURE NOT FULL COLD. Select full cold, at least 10 seconds then actuate at least 3 seconds toward HOT.

NOTE

Operation in manual mode, full cold, above 31,000 feet, particularly at low (climb) airspeed may result in air cycle machine overtemperature and shutdown. In the unlikely event that this should occur, refer to Abnormal Procedures, EMERGENCY PRESSURIZATION ON.

EMERGENCY PRESSURIZATION ON (AUTOMATIC ACTUATION) (EMERG PRESS ON LIGHT ON)

Indicates air cycle machine shutdown or failure.

1. NORM Pressurization Circuit Breaker - CHECK IN.
2. Temperature Control - ADJUST TO WARMER SETTING (may require manual mode).

NOTE

A time delay relay will lock the system into emergency pressurization if air cycle machine temperature remains too high for 12 seconds or more. If machine cools sufficiently in less than 12 seconds, the system will automatically return to the previously selected mode.

3. Pressurization Source Selector - EMER.

NOTE

Wait at least one minute after pressurization source selector has been positioned to EMER before making next selection.

4. Pressurization Source Selector - RH, LH or NORM.

IF EMERGENCY PRESSURIZATION REMAINS ON

5. Pressurization Source Selector - EMER.
6. Control cabin temperature with LH throttle.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Operating Procedures, Abnormal Procedures, page 3-31, change the AIR CYCLE MACHINE (ACM) procedure.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-31.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Abnormal Procedures, page 3-31, change the AIR CYCLE MACHINE (ACM) OVERPRESSURE (ACM O'PRESS LIGHT ON) procedure as follows:

AIR CYCLE MACHINE (ACM) OVERPRESSURE (ACM O'PRESS LIGHT ON)

ON THE GROUND

1. Reduce power on right engine to idle.
2. Pressurization Source Selector - NORM.
3. NORM PRESS Circuit Breaker - PULL and RESET.

NOTE

If ACM O'PRESS light remains illuminated, do not fly the airplane until the malfunction has been repaired.

IN FLIGHT

1. Pressurization Source Selector - RH, reduce power on right engine to 80% N_2.
2. EMER PRESS Circuit Breaker - PULL.
3. NORM PRESS Circuit Breaker - PULL and RESET.
4. EMER PRESS Circuit Breaker - RESET.

NOTE

If ACM O'PRESS light remains on, operate the right engine below 80% N_2. Operate left engine normally.

APPROVED BY [signature]
for Margaret Kline, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas
DATE OF APPROVAL 2/27/07

CABIN ALTITUDE ABOVE SELECTED ALTITUDE

1. Cabin Altitude Selector - SET to lower cabin altitude.
2. Rate Control - FULL INCREASE.
3. Pressurization Source selector - EMER.

IF NOT ARRESTED BY 14,000 FEET CABIN ALTITUDE

4. Oxygen Masks - DON and 100% oxygen.
5. Emergency Descent - AS REQUIRED.
6. Passenger Oxygen - ENSURE passengers are receiving oxygen.
7. Oxygen Microphone Switches - MIC OXY MASK.
8. Transponder - EMERGENCY.

AIR CYCLE MACHINE (ACM) OVERPRESSURE (ACM O'PRESS LIGHT ON)

ON THE GROUND

1. Do not fly the airplane until the malfunction has been repaired.

IN FLIGHT

1. Pressurization Source Selector - RH, reduce power on right engine to 80% N_2.
2. EMER PRESS Circuit Breaker - PULL.
3. NORM PRESS Circuit Breaker - PULL and RESET.
4. EMER PRESS Circuit Breaker - RESET.

NOTE

If ACM O'PRESS light remains on, operate the right engine below 80% N_2. Operate left engine normally.

VACUUM SYSTEM FAILURE

NOTE

EMER DUMP valve will be inoperative. Cabin will go to maximum differential pressure.

1. Pressurization Source Selector - RH or LH, (reduce power to 70% N_1 RPM on selected side).
2. Pressurization Source Selector - OFF before landing.

ELECTRIC ELEVATOR RUNAWAY TRIM

1. Autopilot/Trim Disengage Switch - PRESS and RELEASE.
2. PITCH TRIM circuit breaker - PULL.
3. Manual Elevator Trim - AS REQUIRED.

ELECTRIC TRIM INOPERATIVE

1. Electric Trim Circuit Breaker (PITCH TRIM) - CHECK CIRCUIT BREAKER IN.

IF STILL INOPERATIVE

2. Manual Elevator Trim - AS REQUIRED.

NOTE

Do not attempt to use the autopilot if the electric trim is inoperative. The autopilot will not be able to trim out servo torque, and disengaging the autopilot could result in a significant pitch upset.

JAMMED ELEVATOR TRIM TAB

CRUISE

1. Maintain trim speed as long as practical. Do not extend flaps for approach or landing. Refer to Abnormal Procedures, FLAPS INOPERATIVE APPROACH and LANDING.

TAKEOFF OR GO-AROUND

1. Reduce power as necessary to maintain 120 KIAS or less. Do not change flap position. Minimum speed is V_{REF} for FULL flaps, V_{APP} for 15° flaps or V_{REF} +15 KIAS for 7° or 0° flaps. Do not retract landing gear. Land as soon as practical.

NOTE

Do not attempt to use the autopilot if the electric trim is inoperative. The autopilot will not be able to trim out servo torque, and disengaging the autopilot could result in a significant pitch upset.

ENGINE ANTI-ICE FAILURE (ENG ANTI-ICE LH OR RH LIGHT ON)

IN FLIGHT (Steady Illumination)

1. Throttle - INCREASE POWER.
2. Engine Anti-Ice Controls - CHECK SWITCHES and CIRCUIT BREAKERS.

IF ENGINE ANTI-ICE LIGHT REMAINS ON (AFTER TWO MINUTES)

3. Leave icing environment.

NOTE

The CROSSFEED (XFD) position of the Engine Anti-Ice Switch is designed to provide wing anti-ice protection to both wings in the event of an inoperative engine. Crossfeed (XFD) disables the selected inlet temperature and starter valve inputs to the anti-ice failure annunciators.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru –0538.
Description of Change:	Section III, Operating Procedures, Abnormal Procedures, add "Severe icing Encounter" information.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-32.
Removal Instructions:	This temporary change must be removed and discarded when Revision 14 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Abnormal Procedures, on page 3-32, add "SEVERE ICING ENCOUNTER" information after the current paragraph of the subheading "JAMMED ELEVATOR TRIM TAB" and before the subheading "ENGINE ANTI-ICE FAILURE (ENG ANTI-ICE LH OR RH LIGHT ON)":

SEVERE ICING ENCOUNTER

In conjunction with the "Operations in Severe Icing Conditions" section in the Operation limitations and the "Operations in Severe Icing Conditions" section in the Normal Procedure, this section meets the requirements to be in compliance with AD98-04-38.

Severe icing may be encountered at temperatures as cold as -18°C. Increased vigilance is required at temperatures around 0°C ambient air temperature with visible moisture present.

NOTE

The following weather conditions may be conducive to severe in-flight icing conditions:

- Visible rain at temperatures colder than 0°C ambient air temperature.
- Droplets that splash or splatter at temperatures colder than 0°C ambient air temperature.

IF SEVERE ICING IS PRESENT

One or more of the following visual cues indicates severe icing conditions:

- Unusually extensive ice accumulations on the airframe and windshield in areas not normally observed to collect ice.
- Accumulation of ice on the upper surface of the wing aft of the protected area.

1. Immediately report weather conditions and request priority handling from Air Traffic Control to facilitate a route or altitude change to exit the severe icing conditions.
2. Flaps - LEAVE IN CURRENT POSITION (Do not extend or retract until airframe is clear of ice).

NOTE

Operation with flaps extended can result in a reduced wing angle-of-attack with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.

(Continued Next Page)

3. Autopilot – Hold control wheel firmly and DISENGAGE.

CAUTION

EXERT CONTROL WHEEL FORCE AS REQUIRED TO MAINTAIN DESIRED FLIGHT PATH.

4. Avoid abrupt and excessive maneuvering that may aggravate control problems.
5. If unusual or uncommanded roll is encountered – REDUCE ANGLE OF ATTACK.

APPROVED BY ~~Margaret Kline, Manager~~

for Margaret Kline, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 7/13/07

WING BLEED AIR OVERHEAT (WING O'HEAT LH OR RH LIGHT ON)

CONTINUOUS ILLUMINATION

1. Affected Wing - DECREASE POWER (affected engine).

IF LIGHT DOES NOT EXTINGUISH

2. Leave icing environment.
3. Engine Anti-Ice Switch - OFF.

WINDSHIELD BLEED AIR FAILURE

LOSS OF HOT AIR SUPPLY (VALVE WILL NOT OPEN OR POSSIBLE LINE FAILURE)

1. Windshield Bleed Air Switch and Valves - OFF.
2. Windshield Alcohol Anti-Ice - AS REQUIRED.
3. Leave icing environment as soon as possible.

NOTE

10 minutes alcohol available to pilot's windshield only.

WINDSHIELD AIR OVERHEAT (W/S AIR O'HEAT LIGHT ON)

WINDSHIELD BLEED SWITCH LOW OR HI (AIR FLOW CYCLES OFF AND ON)

MOMENTARY ILLUMINATION

1. If Windshield Bleed Air Switch is HI - SELECT LOW.
2. Windshield Bleed Air Valves - REDUCE.

CONTINUOUS ILLUMINATION (AIRFLOW STOPS, PROBABLE CONTROLLER FAILURE).

1. Windshield Bleed Air Switch and Valves - OFF.
2. Windshield Alcohol Anti-Ice - AS REQUIRED.
3. Leave icing environment.

NOTE

10 minutes alcohol available to pilot's windshield only.

WINDSHIELD BLEED SWITCH OFF

W/S AIR O'HEAT LIGHT ON MOMENTARY OR CONTINUOUS

Indicates probable solenoid valve failure or leak. Windshield air temperature is not regulated. Windshield heat damage is possible. Maintenance is required.

1. Windshield Bleed Air Manual Valves - CLOSE.

PITOT-STATIC HEATER FAILURE (P/S HTR OFF, LH, RH, OR STBY P/S HTR OFF LIGHT MAY BE ON)

1. Pitot-Static Switch and Circuit Breakers - CHECK.
2. Determine Inoperative System.

NOTE

The autopilot references the pilot's (LH) or co-pilot's (RH) pitot-static system; therefore, the altitude hold and speed hold functions may be inoperative if the coupled side pitot-static system fails in icing conditions. Autopilot may be transferred to operative side.

ANGLE-OF-ATTACK PROBE HEATER FAILURE (AOA HTR FAIL LIGHT ON)

Indicates that the angle of attack probe heating element has failed.

1. Pitot-Static Switch and AOA HTR Circuit Breaker - CHECK.
2. Leave icing environment.

NOTE

If the AOA probe heater fails and the AOA probe becomes iced, the stick shaker may not function.

PFD ATTITUDE FAILURE - SINGLE (ATT FAIL ANNUNCIATOR ILLUMINATED)

1. ATT REV Button - PUSH (applicable display). Verify that amber ATT2 or ATT1 is displayed in pilot's and copilot's PFD.

PFD HEADING FAILURE - SINGLE (HDG ANNUNCIATOR ILLUMINATED)

1. HDG REV Button - PUSH (applicable display). Verify that amber MAG2 or MAG1 is displayed in pilot's and copilot's PFD.

NOTE

The HDG REV button may require more than one push to select heading reversion mode. Reversion is verified by observing an amber MAG1 or MAG2, as appropriate, in each PFD.

AIR DATA COMPUTER FAILURE - SINGLE (ADC ANNUNCIATOR ILLUMINATED)

1. ADC Button - PUSH (applicable display). Verify that amber, ADC2 or ADC1 is displayed in pilot's and copilot's PFD.

WING BLEED AIR OVERHEAT (WING O'HEAT LH OR RH LIGHT ON)

CONTINUOUS ILLUMINATION

1. Affected Wing - DECREASE POWER (affected engine).

IF LIGHT DOES NOT EXTINGUISH

2. Leave icing environment.
3. Engine Anti-Ice Switch - OFF.

WINDSHIELD BLEED AIR FAILURE

LOSS OF HOT AIR SUPPLY (VALVE WILL NOT OPEN OR POSSIBLE LINE FAILURE)

1. Windshield Bleed Air Switch and Valves - OFF.
2. Windshield Alcohol Anti-Ice - AS REQUIRED.
3. Leave icing environment as soon as possible.

NOTE

10 minutes alcohol available to pilot's windshield only.

WINDSHIELD AIR OVERHEAT (W/S AIR O'HEAT LIGHT ON)

WINDSHIELD BLEED SWITCH LOW OR HI (AIR FLOW CYCLES OFF AND ON)

MOMENTARY ILLUMINATION

1. If Windshield Bleed Air Switch is HI - SELECT LOW.
2. Windshield Bleed Air Valves - REDUCE.

CONTINUOUS ILLUMINATION (AIRFLOW STOPS, PROBABLE CONTROLLER FAILURE).

1. Windshield Bleed Air Switch and Valves - OFF.
2. Windshield Alcohol Anti-Ice - AS REQUIRED.
3. Leave icing environment.

NOTE

10 minutes alcohol available to pilot's windshield only.

WINDSHIELD BLEED SWITCH OFF

W/S AIR O'HEAT LIGHT ON MOMENTARY OR CONTINUOUS

Indicates probable solenoid valve failure or leak. Windshield air temperature is not regulated. Windshield heat damage is possible. Maintenance is required.

1. Windshield Bleed Air Manual Valves - CLOSE.

PITOT-STATIC HEATER FAILURE (P/S HTR OFF, LH, RH, OR STBY P/S HTR OFF LIGHT MAY BE ON)

1. Pitot-Static Switch and Circuit Breakers - CHECK.
2. Determine Inoperative System.

NOTE

The autopilot references the pilot's (LH) or co-pilot's (RH) pitot-static system; therefore, the altitude hold and speed hold functions may be inoperative if the coupled side pitot-static system fails in icing conditions. Autopilot may be transferred to operative side.

ANGLE-OF-ATTACK PROBE HEATER FAILURE (AOA HTR FAIL LIGHT ON)

Indicates that the angle of attack probe heating element has failed.

1. Pitot-Static Switch and AOA HTR Circuit Breaker - CHECK.
2. Leave icing environment.

NOTE

If the AOA probe heater fails and the AOA probe becomes iced, the stick shaker may not function.

PFD ATTITUDE FAILURE - SINGLE (ATT FAIL ANNUNCIATOR ILLUMINATED)

1. ATT REV Button - PUSH (applicable display). Verify that amber ATT2 or ATT1 is displayed in pilot's and copilot's PFD.

PFD HEADING FAILURE - SINGLE (HDG ANNUNCIATOR ILLUMINATED)

1. HDG REV Button - PUSH (applicable display). Verify that amber MAG2 or MAG1 is displayed in pilot's and copilot's PFD.

AIR DATA COMPUTER FAILURE - SINGLE (ADC ANNUNCIATOR ILLUMINATED)

1. ADC Button - PUSH (applicable display). Verify that amber, ADC2 or ADC1 is displayed in pilot's and copilot's PFD.

WING BLEED AIR OVERHEAT (WING O'HEAT LH OR RH LIGHT ON)

CONTINUOUS ILLUMINATION

1. Affected Wing - DECREASE POWER (affected engine).

IF LIGHT DOES NOT EXTINGUISH

2. Leave icing environment.
3. Engine Anti-Ice Switch - OFF.

WINDSHIELD BLEED AIR FAILURE

LOSS OF HOT AIR SUPPLY (VALVE WILL NOT OPEN OR POSSIBLE LINE FAILURE)

1. Windshield Bleed Air Switch and Valves - OFF.
2. Windshield Alcohol Anti-Ice - AS REQUIRED.
3. Leave icing environment as soon as possible.

NOTE

10 minutes alcohol available to pilot's windshield only.

WINDSHIELD AIR OVERHEAT (W/S AIR O'HEAT LIGHT ON)

WINDSHIELD BLEED SWITCH LOW OR HI (AIR FLOW CYCLES OFF AND ON)

MOMENTARY ILLUMINATION

1. If Windshield Bleed Air Switch is HI - SELECT LOW.
2. Windshield Bleed Air Valves - REDUCE.

CONTINUOUS ILLUMINATION (AIRFLOW STOPS, PROBABLE CONTROLLER FAILURE).

1. Windshield Bleed Air Switch and Valves - OFF.
2. Windshield Alcohol Anti-Ice - AS REQUIRED.
3. Leave icing environment.

NOTE

10 minutes alcohol available to pilot's windshield only.

WINDSHIELD BLEED SWITCH OFF

W/S AIR O'HEAT LIGHT ON MOMENTARY OR CONTINUOUS

Indicates probable solenoid valve failure or leak. Windshield air temperature is not regulated. Windshield heat damage is possible. Maintenance is required.

1. Windshield Bleed Air Manual Valves - CLOSE.

PITOT-STATIC HEATER FAILURE (P/S HTR OFF, LH, RH, OR STBY P/S HTR OFF LIGHT MAY BE ON)

1. Pitot-Static Switch and Circuit Breakers - CHECK.
2. Determine Inoperative System.

NOTE

The autopilot references the pilot's (LH) or co-pilot's (RH) pitot-static system; therefore, the altitude hold and speed hold functions may be inoperative if the coupled side pitot-static system fails in icing conditions. Autopilot may be transferred to operative side.

ANGLE-OF-ATTACK PROBE HEATER FAILURE (AOA HTR FAIL LIGHT ON)

Indicates that the angle of attack probe heating element has failed.

1. Pitot-Static Switch and AOA HTR Circuit Breaker - CHECK.
2. Leave icing environment.

NOTE

If the AOA probe heater fails and the AOA probe becomes iced, the stick shaker may not function.

PFD ATTITUDE FAILURE - SINGLE (ATT FAIL ANNUNCIATOR ILLUMINATED)

1. ATT REV Button - PUSH (applicable display). Verify that amber ATT2 or ATT1 is displayed in pilot's and copilot's PFD.

PFD HEADING FAILURE - SINGLE (HDG ANNUNCIATOR ILLUMINATED)

1. HDG REV Button - PUSH (applicable display). Verify that amber MAG2 or MAG1 is displayed in pilot's and copilot's PFD.

NOTE

The HDG REV button may require more than one push to select heading reversion mode. Reversion is verified by observing an amber MAG1 or MAG2, as appropriate, in each PFD.

AIR DATA COMPUTER FAILURE - SINGLE (ADC ANNUNCIATOR ILLUMINATED)

1. ADC Button - PUSH (applicable display). Verify that amber, ADC2 or ADC1 is displayed in pilot's and copilot's PFD.

COMPARISON MONITOR ALERT (PFD ANNUNCIATOR ILLUMINATED)

Indicates one or more of the following parameters has exceeded its predetermined tolerance level:

PFD ANNUNCIATOR	PARAMETER
PIT	Pitch Attitude
ROL	Roll Attitude
HDG	Heading
LOC	Localizer
ATT	Roll and Pitch Attitude
GS	Glideslope
ILS	Glideslope and Localizer
IAS	Airspeed
ALT	Altitude
RA	Radio Altitude

1. Autopilot/trim disengage Switch - PRESS.

NOTE

The autopilot must remain OFF.

SYMBOL GENERATOR FAILURE - SINGLE (RED "X" OR BLANK PFD)

1. MFD Controller Mode Select Knob - SELECT opposite side symbol generator (either SG1 or SG2).
2. PFD display - VERIFY amber SG1 or SG2 (as appropriate) annunciated in both PFDs.

NOTE

The reversion side mode select panel will be inoperative. FD modes and autopilot coupling (if desired) must be selected from non-reversion side only.

PRIMARY FLIGHT DISPLAY FAILURE (PILOT'S OR COPILOT'S TUBE BLANK)

ON GROUND

NOTE

A failed display unit in either pilot's or co-pilot's PFD position may be interchanged with the MFD display unit to allow dispatch with two functioning PFDs. Access to the removal screw is gained by removing the lower bezels.

(Continued next page)

PRIMARY FLIGHT DISPLAY FAILURE (PILOT'S OR COPILOT'S TUBE BLANK) (Continued)

CAUTION

WHEN THE MFD DISPLAY UNIT IS INOPERATIVE, THE FOLLOWING AVIONICS EQUIPMENT WILL NOT BE AVAILABLE:

- TAKEOFF V SPEED DISPLAY
- LANDING V SPEED DISPLAY
- HONEYWELL VNAV
- TCAS DISPLAY (OPTIONAL)

IN FLIGHT

1. Dim Button (applicable display) - OFF.

NOTE

Turning off the applicable DIM knob on the DC-550 display controller will cause the PFD information to be displayed on the MFD.

PRIMARY FLIGHT DISPLAY OR MULTIFUNCTION DISPLAY FAN FAILURE (PFD FAN or MFD FAN LIGHT ON)

ILLUMINATION ON GROUND

Indicates failure of the pilot's or copilot's PFD or MFD cooling fan.

1. Ground Operating Time - DO NOT EXCEED 10 MINUTES.

IF GROUND OPERATING TIME EXCEEDS 10 MINUTES

2. Circuit Breakers (RH Panel) - PULL PFD 1, PFD 2, EFIS CONTL 1, EFIS CONTL 2, and/or MFD CONTL (as appropriate).

CAUTION

ELECTRICAL POWER MUST BE REMOVED FROM EFIS SYSTEM TO PREVENT OVERHEATING DURING GROUND OPERATIONS.

3. Prior to takeoff - RESET CIRCUIT BREAKERS PFD1, PFD2, EFIS1, EFIS2 and/or MFD (as appropriate).
4. PFD's or MFD Hot Annunciators - MONITOR.
5. Return to normal procedures.

ILLUMINATION IN FLIGHT

Indicates failure of the pilot's or copilot's PFD or MFD cooling fan.

1. PFD's or MFD Hot Annunciators - MONITOR.

PRIMARY FLIGHT DISPLAY OR MULTIFUNCTION DISPLAY OVERTEMPERATURE (PFD HOT OR MFD HOT LIGHT ON)

ILLUMINATION IN FLIGHT

The HOT light has probable illumination due to an overtemperature condition caused by failure of the internal fan. Continued use of the display without the fan may lead to display failure. Removing power from the display will allow it to cool, but restoring power will likely result in another overtemperature indication. Consideration should be given to leaving the circuit breaker disengaged, using the opposite side PFD or PFD reversion to MFD (as appropriate) to complete the flight and, if necessary, restoring power to the display for the approach and landing. Pulling the PFD1 or PFD2 or MFD circuit breakers (as appropriate) will enable the display tubes to cool.

1. Cockpit Temperature - Select MANUAL COLD or AUTOMATIC COLD above 31,000 feet.
2. Dim and Raster Dim - REDUCE BRIGHTNESS to a minimum level on affected display.

IF OVERTEMPERATURE ANNUNCIATION PERSISTS

3. PFD or MFD Circuit breakers - PULL.
4. Dim Knob (affected PFD display) - OFF operate on reversionary mode as applicable.

NOTE

If pilot or copilot's PFD is the affected display, the output of the applicable DGC may be displayed on the MFD by turning the dim knob on the affected PFD controller to OFF.

5. Land as soon as practical.

ON GROUND

1. Determine cause prior to flight.

DISPLAY GUIDANCE COMPUTER COOLING FAN FAILURE (IC1 OR IC2 FAN LIGHT ON)

ILLUMINATED ON THE GROUND

Indicates failure of the display guidance computer cooling fan.

1. Ground Operating Time - DO NOT EXCEED 10 MINUTES.

IF GROUND OPERATING TIME EXCEEDS 10 MINUTES

2. Circuit Breakers (RH Panel) - PULL PFD1, PFD2, and/or MFD (as appropriate).

CAUTION

ELECTRICAL POWER MUST BE REMOVED FROM EFIS SYSTEM TO PREVENT OVERHEATING DURING GROUND OPERATIONS.

(Continued next page)

DISPLAY GUIDANCE COMPUTER COOLING FAN FAILURE (IC1 OR IC2 FAN LIGHT ON) (Continued).

3. Prior to takeoff - RESET CIRCUIT BREAKERS PFD1, PFD2, and/or MFD (as appropriate).
4. IC1 and IC2 Hot Annunciators - MONITOR.
5. Return to normal procedures.

ILLUMINATION IN FLIGHT

Indicates failure of the display guidance computer cooling fan.

1. IC1 and IC2 Hot Annunciators - MONITOR.

AUTOPILOT OUT OF TRIM (AP ROLL OR AP PITCH MISTRIM ANNUNCIATOR ILLUMINATED)

1. Autopilot Disconnect Button - PRESS.

CAUTION

BE PREPARED FOR MINOR CONTROL WHEEL FORCE REQUIRED TO MAINTAIN DESIRED FLIGHT PATH.

2. Elevator or aileron trim wheels - ADJUST as required.
3. Autopilot Button - ENGAGE as desired.

DISPLAY GUIDANCE COMPUTER OVERTEMPERATURE (IC1 OR IC2 HOT LIGHT ON)

ILLUMINATION IN FLIGHT

The HOT light has probably illuminated due to an overtemperature condition caused by failure of the internal fan. Continued use of the guidance computer without the fan may lead to computer failure. Removing power from the computer will allow it to cool, but restoring power will likely result in another overtemperature indication. Consideration should be given to leaving the circuit breaker disengaged using the opposite side computer for the approach and landing. Pulling the DGC1 or DGC2 circuit breakers (as appropriate) will enable the computer to cool.

1. DGC1 or DGC2 Circuit Breaker - PULL.
2. Land as soon as practical.

NOTE

The output of the unaffected display guidance computer may be used to drive all three displays by placing the SG reversion knob located on the MFD controller to SG1 or SG2 as appropriate.

ON GROUND

1. Determine cause prior to flight.

LOSS OF TAS INPUT TO FLIGHT GUIDANCE SYSTEM

1. Failure Side - DETERMINE.

NOTE

- Failure of TAS input to the pilot's side will generate a 'TAS FAIL' message from FMS as well as blanking the displayed value of TAS on the MFD. Failure of TAS input to the co-pilot's side will not result in any message annunciation.

- Autopilot performance when coupled to the side with a failed TAS input will be significantly degraded in other than approach phases of flight.

2. SG Reversion Knob - SG1 or SG2. (Revert to cross side symbol generator with operable TAS input).

NOTE

Autopilot must be coupled to side consistent with selected symbol generator.

NOSE AVIONIC FAN FAILURE (NOSE AVN FAN FAIL ANNUNCIATOR ILLUMINATED)

ON GROUND

1. Ground Operating Time - LIMIT TO 30 MINUTES.

IN FLIGHT

1. Flight may be continued in a normal manner.

LANDING GEAR WILL NOT EXTEND

1. Landing Gear Handle - CHECK DOWN (airspeed below 200 KIAS).
2. Gear Control Circuit Breaker - CHECK IN.
3. Auxiliary Gear Control - PULL T-HANDLE and ROTATE TO LOCK.
4. Rudder - YAW AIRPLANE if necessary to achieve downlock light.

CAUTION

IF DOWNLOCK LIGHTS DO NOT ILLUMINATE, ASSURE VISUALLY IF POSSIBLE THAT ALL LANDING GEARS HAVE BEEN RELEASED FROM THE UPLOCKS PRIOR TO USING THE BLOWDOWN SYSTEM. THE BLOWDOWN WILL NOT REMOVE THE GEAR FROM THE UPLOCKS.

5. Auxiliary Gear Control - PULL KNOB TO BLOW DOWN (for positive lock).

NOTE

Pneumatic pressure should be used to assure positive locking of all three gear actuators.

LOW HYDRAULIC FLOW (HYD FLOW LOW LH OR RH LIGHT ON)

Indicates inoperative left or right hydraulic pump.

ANTISKID SYSTEM FAILURE (ANTISKID INOP LIGHT ON, POWER BRAKE LOW PRESS LIGHT OUT)

1. Antiskid Switch - ON.
2. Skid Control Circuit Breaker - RESET.

IF LIGHT REMAINS ON

3. Antiskid Switch - OFF.
4. Multiply landing distance of Figure 4-35 by 1.25.

CAUTION

DIFFERENTIAL POWER BRAKING IS AVAILABLE. HOWEVER, SINCE THE ANTISKID IS INOPERATIVE, EXCESSIVE PRESSURE ON THE BRAKE PEDALS MAY CAUSE WHEEL BRAKES TO LOCK, RESULTING IN TIRE BLOWOUT.

5. Be prepared to use the emergency brake system.

NOTE

If the antiskid hydraulic pump fails after the accumulator pressure exceeds 750 psi, the POWER BRAKE LOW PRESS light may not illuminate until normal brakes are used.

HYDRAULIC SYSTEM REMAINS PRESSURIZED (HYD PRESS ON LIGHT REMAINS ON AFTER SYSTEM CYCLE IS COMPLETED)

1. Speed Brakes Control Circuit Breaker - PULL.
2. Landing Gear Control Circuit Breaker - PULL.
3. Flaps Control Circuit Breaker - PULL.
4. Thrust Reverser Circuit Breakers - PULL (one at a time).

IF SYSTEM DEPRESSURIZED

5. Circuit Breakers - RESET (one at a time). Leave pulled circuit breaker which caused system to depressurize.
6. Land as soon as practical. Reset Speed Brakes Control, Landing Gear, or Flaps (not thrust reverser) Circuit Breakers prior to landing, if pulled.

IF SYSTEM REMAINS PRESSURIZED (Indicates bypass valve failed)

5. Control Circuit Breakers - RESET (one at a time).
6. Land as soon as possible. If system bypass valve fails, the hydraulic system may overheat.

BAGGAGE DOOR NOT LOCKED (BAGGAGE DOOR LH OR RH ANNUNCIATOR ILLUMINATED)

Indicates unlocked/unlatched (key) nose baggage door (LH or RH).

ON GROUND

1. Correct condition prior to flight.

IN FLIGHT

1. Airspeed - REDUCE.
2. Passenger Advisory Light - PASS SAFETY.

CABIN DOOR NOT LOCKED (CABIN DOOR ANNUNCIATOR ILLUMINATED)

Indicates failure or improper position of door switch and/or possible disengagement of the lower forward cabin door pin.

ON THE GROUND

1. Correct condition prior to flight.

IN FLIGHT

1. Cabin Altitude - SELECT to 9500 feet.
2. Airspeed - REDUCE.
3. Passenger Advisory Light - PASS SAFETY.
4. Cabin Door - KEEP CLEAR.
5. Altitude - DESCEND to a lower altitude.
6. Land as soon as practical.

TAILCONE DOOR NOT LOCKED (TAILCONE DOOR ANNUNCIATOR ILLUMINATED)

Indicates unlocked/unlatched (key) tailcone baggage door.

ON THE GROUND

1. Correct condition prior to flight.

IN FLIGHT

1. Airspeed - REDUCE.
2. Passenger Advisory Light - PASS SAFETY.

CABIN DOOR PRESSURE SEAL FAILURE (DOOR SEAL ANNUNCIATOR ILLUMINATED)

DOOR SEAL LIGHT ON IN FLIGHT

1. Descend to 41,000 feet (or lower).
2. Pilot - DON CREW OXYGEN MASK.
3. Passenger Advisory Light - PASS SAFETY.
4. Land as soon as practical.

LOW HYDRAULIC FLUID LEVEL (HYD LOW LEVEL LIGHT ON)

1. Land as soon as practical.

NOTE

The speed brakes, thrust reversers and flaps may not operate. If the flaps lever is moved, the flaps may tend to float in a trail position. The landing gear may not operate using normal procedures.

POWER BRAKE SYSTEM FAILURE (POWER BRAKE LOW PRESS AND ANTISKID INOP LIGHTS ON)

1. Skid Control Circuit Breaker - RESET.

IF LIGHT REMAINS ON

2. Plan to use the emergency brake system for landing.
3. Brake Pedals - REMOVE FEET FROM BRAKE PEDALS.
4. Emergency Brake Handle - PULL as required.

CAUTION

ANTISKID SYSTEM DOES NOT FUNCTION DURING EMERGENCY BRAKING. EXCESSIVE PRESSURE ON EMERGENCY BRAKE HANDLE CAN CAUSE BOTH WHEEL BRAKES TO LOCK, RESULTING IN BLOWOUT OF BOTH TIRES.

5. Multiply the landing distance of Figure 4-35 by 1.3.

WHEEL BRAKE FAILURE

1. Brake Pedals - REMOVE FEET from BRAKE PEDALS.
2. Emergency Brake Handle - PULL as required.

CAUTION

ANTISKID SYSTEM DOES NOT FUNCTION DURING EMERGENCY BRAKING. EXCESSIVE PRESSURE ON EMERGENCY BRAKE HANDLE CAN CAUSE BOTH WHEEL BRAKES TO LOCK, RESULTING IN BLOWOUT OF BOTH TIRES.

3. Multiply the landing distance of Figure 4-35 by 1.3.

SINGLE-ENGINE REVERSING

1. Throttles - IDLE.
2. Brakes - APPLY.
3. Speed Brakes - EXTEND.
4. Thrust Reverser - DEPLOY (after nose wheel on ground).
5. Reverser Indicator Lights - CHECK ILLUMINATION of ARM, UNLOCK and DEPLOY LIGHTS.
6. Reverser Power - AS REQUIRED.
7. Thrust Reverser - REVERSER LEVER TO IDLE REVERSE AT 60 KIAS.

NOTE

Reverse thrust may need to be reduced during crosswind landings on wet or icy runways.

SINGLE-ENGINE APPROACH AND LANDING

1. Seats, Seat Belts and Shoulder Harnesses - SECURE.
2. Avionics and Flight Instruments - CHECK and SET.
3. Radar Altimeter - SET.
4. V_{REF} and Fan Speed Settings - CONFIRM.
5. Passenger Advisory Lights - PASS SAFETY.
6. Passenger Seats - CHECK UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
7. Flaps - TAKEOFF and APPROACH.
8. Engine Synchronizer - OFF.
9. Ground Idle Switch - NORM; unless ground icing anticipated - HIGH.
10. Fuel Crossfeed - CHECK.
11. Ignition (operating engine) - ON.
12. Landing Gear - DOWN and LOCKED.
13. Antiskid - CHECK ON.
14. Landing Lights - ON.
15. Airspeed - V_{APP} Minimum.
16. Autopilot and Yaw Damper - OFF.
17. Pressurization - CHECK ZERO DIFFERENTIAL.
18. Speed Brakes - RETRACTED.
19. Flaps - LAND (when landing assured).
20. Airspeed - V_{REF}.

NOTE

Do not allow N_2 (turbine) RPM to be less than 52%.

GROUND IDLE (GROUND IDLE LIGHT ON IN FLIGHT)

Indicates fuel control is in ground idle mode (46% N_2 turbine RPM). Do not set N_2 turbine RPM below 52% (flight idle). Engine acceleration from ground idle (46% N_2 turbine RPM) may be slow.

IN FLIGHT

1. Ground Idle Switch - HIGH.
2. Engine Synchronizer - OFF.

AFTER LANDING

1. Ground Idle Switch - NORM.

SINGLE-ENGINE GO-AROUND

1. Throttle (operating engine) - TAKEOFF POWER
2. Airplane Pitch Attitude - 10° (Go-around mode on flight director for reference).
3. Flaps - TAKEOFF and APPROACH.

NOTE

The landing gear warning horn can not be silenced if the landing gear is retracted prior to the flaps reaching the TAKEOFF and APPROACH position.

4. Climb Speed - V_{APP} Minimum.
5. Landing Gear - UP (when positive rate-of-climb is established).
6. Flaps (when clear of obstacle) - RETRACT at 400 feet.
7. Climb Speed - V_{ENR}.
8. Thrust - Maximum continuous power.

FLAPS INOPERATIVE APPROACH AND LANDING (NOT IN LANDING POSITION)

1. Seats, Seat Belts and Shoulder Harnesses - SECURE.
2. V_{REF} and fan Speed Settings - CONFIRM.
3. Airspeed - Flaps 15°, V_{REF} + 5 KIAS.
   Flaps 7°, V_{REF} +10 KIAS.
   Flaps 0° or unknown, V_{REF} + 15 KIAS.
4. Flaps Control Circuit Breaker - CHECK IN.
5. Multiply the landing distance of Figure 4-35 by 1.2.
6. Avionics and Flight Instruments - CHECK and SET.
7. Radar Altimeter - SET.
8. Passenger Advisory Lights - PASS SAFETY.
9. Passenger seats - CHECK FULL UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
10. Engine Synchronizer - OFF.
11. Fuel Crossfeed - OFF.
12. Ignition - ON.
13. Landing Gear - DOWN and LOCKED.
14. Antiskid - CHECK ON.
15. Landing Lights - ON.
16. Autopilot and Yaw Damper - OFF.
17. Annunciator Panel - CLEAR.
18. Pressurization - CHECK ZERO DIFFERENTIAL.
19. Speed Brakes - RETRACTED PRIOR TO 50 FEET.

NOTE

Do not allow N_2 (turbine) RPM to be less than 52%.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560 -0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560 -0260 thru -0538.
Description of Change:	Section III, Operating Procedures, Normal Procedures, p. 3-44, replace the TAKEOFF procedure.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-44.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Normal Procedures, page 3-44, replace the TAKEOFF procedure as follows:

TAKEOFF

STATIC TAKEOFF

1. Throttles – SET TAKEOFF N_1.
2. Engine Instruments – CHECK NORMAL.
3. Brakes – RELEASE.

ROLLING TAKEOFF

1. Computed Takeoff Distance – ADD 500 FEET.
2. Brakes – RELEASE.
3. Throttles – SET TAKEOFF N_1 within 500 feet after brake release.
4. Engine Instruments – CHECK NORMAL.

FIREWALL SHUTOFF VALVE (F/W SHUTOFF LH OR RH LIGHT ON)

Operated by engine fire push switches. The respective fuel and hydraulic systems shutoff valves are closed at the applicable firewall and the same side generator field relay is tripped.

ANGLE-OF-ATTACK SYSTEM FAILURE (AMBER AOA ANNUNCIATION IN PFD)

Indicates that a failure exists in the angle of attack and/or stick shaker system which has caused the AOA annunciator to flag. The Stick Shaker may be inoperative. Low speed awareness cues in the PFD will be inoperative.

USE OF SUPPLEMENTAL OXYGEN (UNPRESSURIZED)

1. Oxygen Masks - NORMAL below 25,000 feet cabin altitude.
   - 100% at or above 25,000 feet.
   - Ensure crew and passengers are receiving oxygen.
2. Cabin Altitude - MAX 25,000 FEET with passengers.
   - MAX 37,000 FEET crew only.
3. Oxygen - CHECK ENDURANCE (refer to Figure 3-3).
4. Range - COMPUTE, (based on oxygen endurance and revised fuel flow and ground speed).

MASTER WARNING LIGHT ON STEADY

1. Warning Light Circuit Breaker - CHECK.
2. Instruments (hydraulic, electrical and engine) - MONITOR.

MASTER WARNING LIGHT ON STEADY OR FLASHING, NO WARNING LIGHTS ILLUMINATED

1. Master Warning - PRESS to reset.
2. Warning Light Circuit Breaker - CHECK.
3. Instruments (electrical and engine) - MONITOR.

SPEED BRAKES (SPD BRK EXTEND ADVISORY LIGHT ON)

Normal indication if speed brakes are extended.

IF SPEED BRAKES FAIL TO STOW

1. Speed Brake Circuit Breaker (LH Panel) - PULL.
2. Speed Brake Position - VERIFY visually that speed brakes have blown back to a near flush position.

LANDING WITH FAILED PRIMARY FLIGHT CONTROL CABLE

RUDDER

1. Utilize rudder trim.
2. After touchdown, lower the nose and deploy speed brakes as soon as possible.

NOTE

Use of thrust reversers during landing rollout is not recommended.

AILERON

1. Use rudder for directional control limiting bank angle to 15 degrees maximum. Do not use aileron trim except for gross adjustments.
2. If possible, choose a runway with least possible crosswind.
3. After touchdown, lower the nose and extend speed brakes as soon as possible.

ELEVATOR

1. Use manual elevator trim wheel for primary pitch control. Do not use electric trim.
2. Make small pitch and power changes and set up landing configuration early.
3. After touchdown and nose wheel on ground, extend speed brakes and apply wheel brakes as soon as possible.

WARNING

DO NOT DEPLOY THRUST REVERSERS DURING LANDING ROLLOUT.

NORMAL PROCEDURES
TABLE OF CONTENTS

NORMAL PROCEDURES
TABLE OF CONTENTS

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation V Ultra (560-0260 thru -0538), basic FAA Approved Airplane Flight Manual Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Operating Procedures, Normal Procedures, Preliminary Cockpit Inspection, add Note after step 5, page 3-49.
Filing Instructions:	Insert this temporary change in the Model 560 Citation V Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-49.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Normal Procedures, Preliminary Cockpit Inspection, add the following Note after step 5, page 3-49:

NOTE

Refer to Normal Procedures, Oxygen System, Figure 3-4 for dispatch pressures with less than full oxygen bottle.

NORMAL PROCEDURES

PREFLIGHT INSPECTION

1. Battery - CONNECTED.
2. Engine Covers - REMOVED (2 each).
3. Pitot Covers - REMOVED (3 each).

PRELIMINARY COCKPIT INSPECTION

NOTE

Prior to cockpit inspection, check tailcone to ensure battery is connected.

1. Documents - CHECK ABOARD.
   a. To be displayed in airplane at all times:
      (1) Airworthiness and Registration Certificates.
      (2) Transmitter License(s).
   b. To be carried in the airplane at all times:
      (1) FAA Approved Airplane Flight Manual.
      (2) Honeywell Primus 1000 Pilot's Manual.
      (3) Applicable FMS Pilot's Manual.
2. Flashlight - ABOARD.
3. Portable Fire Extinguisher - SERVICED and SECURE.
4. Microphones, Headsets, and Oxygen Masks - ABOARD.
5. Oxygen Quantity - CHECK.
6. Control Lock - UNLOCKED.
7. Gear Handle - DOWN.
8. Rudder, Aileron and Elevator Trim - POSITION trim tab indicator within takeoff trim range.
9. Flaps Handle - AGREES with Flaps position.
10. Left and Right Circuit Breakers - IN.
11. Generators - GEN (OFF, if external power is to be used for start).
12. All other switches - OFF or NORM.
13. Throttles - OFF.
14. Battery Switch - BATT (24 volts minimum).
15. Fuel Quantity - CHECK.
16. Pitot/Static Heat - ON - 30 seconds - OFF.
17. Landing Lights - ON - (check illumination on ground - OFF, if seen from cockpit).
18. Recognition Lights - ON (check illumination).
19. Other External Lights and Passenger Advisory Lights - ON. (check illumination - OFF, if seen from cockpit).

NOTE

- Expedite all checks with electrical power on and ensure that the air conditioner switch is OFF, if external power is not used.
- Landing and nav lights may be omitted if night flight is not anticipated.

EXTERIOR INSPECTION

During inspection, make a general check for security, condition and cleanliness of the airplane and components. Check particularly for damage; fuel, oil and hydraulic fluid leakage; security of access panels; and removal of keys from locks.

1. Hot Items/Lights - CHECK.

(Continued Next Page)

EXTERIOR INSPECTION (Continued)

a. Left and Right Static Ports - CLEAR and WARM.
b. Left and Right Pitot Tubes - CLEAR and HOT.
c. Standby Airspeed Pitot Tube - CLEAR and HOT.
d. Ram Air Temperature Probe - CLEAR.
e. Landing Lights - BOTH ON (if not observed from cockpit).
f. Recognition Lights - BOTH ON (if not observed from cockpit).
g. Angle-of-attack Vane - FREE and HOT.
h. Flashing Beacon - ON and FLASHING (if not observed from cockpit).
i. Right Wing Inspection, Navigation, and Strobe Lights - ON (if not observed from cockpit).
j. Tail Navigation Light - ON.
k. Left Wing Inspection, Navigation, and Strobe Lights - ON (if not observed from cockpit).
l. Lights and Battery Switches - OFF.

2. Left Nose - CHECK.
   a. Brake Fluid Reservoir Sight Gages - FLUID VISIBLE.
   b. Power Brake Accumulator Charge - LIGHT GREEN ARC (precharged pressure) or DARK GREEN ARC (operating pressure if battery was turned on and circuit breaker was in during cockpit inspection).
   c. Baggage Door - SECURE and LOCKED.
   d. Nose Gear, Doors, Wheel and Tire - CONDITION and SECURE.
3. Right Nose and Fuselage Right Side - CHECK.
   a. Windshield Alcohol Reservoir Sight Gage - FLUID VISIBLE.
   b. Brake and Gear Pneumatic Pressure Gage - GREEN ARC.
   c. Baggage Door - SECURE and LOCKED.
   d. Oxygen Blowout Disc - GREEN.
   e. Overboard Vent Lines - CLEAR.
   f. Top and Bottom Antennas - CONDITION and SECURE.
4. Right Wing - CHECK.
   a. Dorsal Fin Air Inlet - CLEAR.
   b. Pylon Tailcone Air Inlet - CLEAR.
   c. Forward T_1 Sensor - CONDITION.
   d. Engine Fan Duct and Fan - CONDITION.

NOTE

If fan is windmilling, install exhaust cover to stop. If any damage is observed, refer to Chapter 72 of the Engine Maintenance Manual.

   e. Generator Cooling Air Inlet - CLEAR.
   f. Wing Inspection Light - CONDITION.
   g. Anti-Ice Bleed Air Cooling Air Inlet - CLEAR.
   h. Heated Leading Edge - CONDITION and VENTS CLEAR.
   i. Fuel Quick Drains - DRAIN and CHECK for contamination (6).
   j. Fuel Filter Drain - DRAIN.
   k. Main Gear Door, Wheel, Tire and Brake - CONDITION and SECURE.
   l. Deice Boot - CONDITION and SECURE.
   m. Fuel Filler Cap - SECURE.
   n. Fuel Tank Vent - CLEAR.
   o. Navigation, Strobe, Landing and Recognition Lights - CONDITION.

(Continued Next Page)

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Operating Procedures, Normal Procedures, p. 3-50, EXTERIOR INSPECTION, add two NOTES.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-50.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Normal Procedures, p. 3-50, EXTERIOR INSPECTION, add a NOTE after step d. and step k. as follows:

EXTERIOR INSPECTION

2. Left Nose – CHECK.

   d. Nose Gear, Doors, Wheel and Tire – CONDITION and SECURE.

NOTE

Chrome showing strut extension should be between 1.2 and 5.0 inches.

4. Right Wing – CHECK

   k. Main Gear Door, Wheel, Tire and Brake – CONDITION and SECURE.

NOTE

Chrome showing strut extension should be between 1.4 and 4.0 inches.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru –0538.
Description of Change:	Section III, Operating Procedures, Normal Procedures, replace item 4 information in EXTERIOR INSPECTION procedures. This temporary change eliminates the need for the second requirement of temporary change 56FMA TC-R11-07, addition of NOTE in step 4.k
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-50.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Normal Procedures, replace item 4 that starts on page 3-50 and ends on 3-51, with the following information:

4. Right Wing – CHECK.
   a. Dorsal Fin Air Inlet – CLEAR.
   b. Pylon Tailcone Air Inlet – CLEAR.
   c. Forward T_1 Sensor – CONDITION.
   d. Engine Fan Duct and Fan - CONDITION.

NOTE

If fan is windmilling, install exhaust cover to stop. If any damage is observed, refer to Chapter 72 of the Engine Maintenance Manual.

   e. Generator Cooling Air Inlet – CLEAR.
   f. Wing Inspection Light – CONDITION.
   g. Anti-Ice Bleed Air Cooling Air Inlet – CLEAR.
   h. Heated Leading Edge – CONDITION and VENTS CLEAR.
   i. Verify proper installation and adhesion of the Stall Strips installed on the wing deice boots.
   j. Fuel Quick Drains – DRAIN and CHECK for contamination (6).
   k. Fuel Filter Drain – DRAIN.
   l. Main Gear Door, Wheel, Tire and Brake – CONDITION and SECURE.

NOTE

Chrome showing strut extension should be between 1.4 and 4.0 inches.

   m. Deice Boot – CONDITION and SECURE.
   n. Fuel Filler Cap – SECURE.
   o. Fuel Tank Vent – CLEAR.
   p. Navigation, Strobe, Landing and Recognition Lights – CONDITION.

(Continued Next Page)

q. Static Wicks – CHECK (5).

NOTE

Maximum of 3 static wicks missing from entire airframe, and no two may be missing consecutively.

r. Ailerons, Flaps and Speed Brakes – CONDITION and SECURE. (Assure flaps position matches indicator).

APPROVED BY M Baker

fa Margaret Kline, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 8/31/07

EXTERIOR INSPECTION (Continued)

p. Static Wicks - CHECK (5).

NOTE

Maximum of 3 static wicks missing from entire airframe, and no two may be missing consecutively.

q. Aileron, Flaps and Speed Brakes - CONDITION and SECURE. (assure flaps position matches indicator).

5. Right Nacelle - CHECK.
   a. Oil Level - CHECK; Filler Cap and Access Door - SECURE.
   b. Generator Cooling Air Exhaust - CLEAR.
   c. Engine Fluid Drain Mast - CLEAR.
   d. Engine Exhaust and Bypass Ducts - CONDITION and CLEAR.
   e. Aft T_1 Sensor - CONDITION.
   f. Thrust Reverser Buckets - CONDITION AND STOWED.
6. Right Empennage - CHECK.
   a. Deice Boot Overboard Vents - CLEAR.
   b. Air Conditioning Overboard Exhaust - CLEAR.
   c. Hydraulic Service Door - SECURE, drain mast clear.
   d. Anti-Ice Bleed Air Cooling Air Exhaust - CLEAR.
   e. Right Horizontal Stabilizer Deice Boot - CONDITION and SECURE.
   f. Right Elevator and Trim Tab - MOVEMENT and CONDITION. Assure trim tab position matches elevator trim tab position indicator.
   g. Tail Mounted Beacon Light - CONDITION.
   h. Tail Skid - CONDITION and SECURE.
   i. Rudder and Trim Tab - SECURE and CORRECT SERVO TAB ACTION.
   j. Static Wicks (Rudder, Vertical Stabilizer and Both Elevators) - CHECK (8).

NOTE

Maximum of 3 static wicks missing from entire airframe, and no two missing consecutively. All 4 elevator static wicks must be installed.

7. Left Empennage - CHECK.
   a. External Power Service Door - SECURE.
   b. Battery Cooling Intake and Vent Lines - CLEAR.
   c. Windshield Heat Exchanger Overboard Exhaust - CLEAR.
   d. Anti-Ice Bleed Air Cooling Air Exhaust - CLEAR.
   e. Left Elevator and Trim Tab - MOVEMENT and CONDITION. Assure trim tab position matches elevator trim tab position indicator.
   f. Left Horizontal Stabilizer Deice Boot - CONDITION and SECURE.
8. Aft Compartment - CHECK.
   a. Hydraulic Fluid Quantity - CHECK.
   b. Fire Bottle Pressure Gages - CHECK temperature pressure relationship.
   c. Junction Box Circuit Breakers - IN.
   d. ACM Oil Level - CHECK.
   e. Tailcone Access Door - SECURE.
   f. Aft Compartment Baggage - SECURE.
   g. Aft Compartment Light - OFF.
   h. Aft Compartment Access Door - SECURE and LOCKED.
9. Left Nacelle - CHECK.
   a. Thrust Reverser buckets - CONDITION AND STOWED.
   b. Aft T_1 Sensor - CONDITION.
   c. Engine Exhaust and Bypass Ducts - CONDITION and CLEAR.

EXTERIOR INSPECTION (Continued)

d. Engine Fluid Drain Mast - CLEAR.
e. Generator Cooling Air Exhaust - CLEAR.
f. Oil Level - CHECK; Filler Cap and Access Door - SECURE.

10. Left Wing - CHECK.
    a. Flap, Speed Brakes, Aileron and Trim Tab - CONDITION and SECURE.
    b. Static Wicks - CHECK. (5)

NOTE

Maximum of 3 static wicks missing from entire airframe, and no two may be missing consecutively.

c. Navigation, Strobe, Landing and Recognition Lights - CONDITION.
d. Fuel Tank Vent - CLEAR.
e. Fuel Filler Cap - SECURE.
f. Deice Boot - CONDITION and SECURE.
g. Main Gear Door, Wheel, Tire and Brake - CONDITION and SECURE.
h. Fuel Filter Drain - DRAIN.
i. Fuel Quick Drains - DRAIN and CHECK for contamination (6).
j. Heated Leading Edge - CONDITION and VENTS CLEAR.
k. Anti-Ice Bleed Air Cooling Air Inlet - CLEAR.
l. Wing Inspection Light - CONDITION.
m. Generator Cooling Air Inlet - CLEAR.
n. Engine Fan Duct and Fan - CONDITION.

NOTE

If fan is windmilling, install exhaust cover to stop. If any damage is observed, refer to Chapter 72 of the Engine Maintenance Manual.

o. Forward T_1 Sensor - CONDITION.
p. Dorsal Fin Air Inlet - CLEAR.
q. Secondary Cabin Door Seal - CHECK for RIPS, TEARS and FOLDING.

CABIN INSPECTION

1. Emergency Exit - SECURE; Handle Lock Pin - REMOVE.
2. Passenger Seats - UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD as required to clear exit doors.
3. Door Entry Lights - OFF.
4. Exit Placard - SECURE.
5. Portable Fire Extinguishers - SERVICED and SECURE.

COCKPIT INSPECTION

1. Oxygen Masks - Checked and Properly stowed (Check mask at 100% and in EMER, Check mic).
2. Oxygen Control Valve - CHECK IN NORMAL.
3. Control Lock - OFF. (Ensure that the handle is fully in, controls and throttle are free).
4. Circuit Breakers - CHECK
5. Generators - GEN (OFF if external power is to be used for start).
6. Ignition - NORM.
7. Boost Pumps - NORM.
8. Fuel Crossfeed - OFF.
9. LH/RH Gyro Slave - AUTO.

(Continued Next Page)

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru –0538.
Description of Change:	Section III, Operating Procedures, Normal Procedures, replace item 10 information in EXTERIOR INSPECTION procedures. This Temporary Change supersedes temporary change 56FMA TC-R11-08 in its entirety.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru –0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-52.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Normal Procedures, replace step 10 on page 3-52 with the following information:

10. Left Wing – CHECK.
    a. Flap, Speed Brakes, Aileron and Trim Tab – CONDITION and SECURE.
    b. Static Wicks – CHECK. (5)

NOTE

Maximum of 3 static wicks missing from entire airframe, and no two may be missing consecutively.

    c. Navigation, Strobe, Landing and Recognition Lights - CONDITION.
    d. Fuel Tank Vent – CLEAR.
    e. Fuel Filler Cap – SECURE.
    f. Deice Boot – CONDITION and SECURE.
    g. Main Gear Door, Wheel, Tire and Brake – CONDITION and SECURE.

NOTE

Chrome showing strut extension should be between 1.4 and 4.0 inches.

    h. Fuel Filter Drain – DRAIN.
    i. Fuel Quick Drains – DRAIN and CHECK for contamination (6).
    j. Heated Leading Edge – CONDITION and VENTS CLEAR.
    k. Verify proper installation and adhesion of the Stall Strips installed on the wing deice boots.
    l. Anti-Ice Bleed Air Cooling Air Inlet – CLEAR.
    m. Wing Inspection light – CONDITION.
    n. Generator Cooling Air Inlet – CLEAR.

(Continued Next Page)

o. Engine Fan Duct and Fan – CONDITION.

NOTE

If fan is windmilling, install exhaust cover to stop. If any damage is observed, refer to Chapter 72 of the Engine Maintenance Manual.

p. Forward T_1 Sensor – CONDITION.
q. Dorsal Fin Air Inlet – CLEAR.
r. Secondary Cabin Door Seal – CHECK for RIPS, TEARS and FOLDING.

APPROVED BY DM Baker
for Margaret Kline, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas
DATE OF APPROVAL 8/31/07

COCKPIT INSPECTION (Continued)

10. Standby Gyro Switch - TEST momentary; Check Green Light ON.
11. Standby Gyro - ON; Check Amber Light ON.
12. Antiskid - ON.
13. Ground Idle Switch - NORM.
14. Engine Synchronizer - OFF.
15. Throttles - CHECK OFF.
16. Pressurization Source Select - AS REQUIRED.
17. Windshield Bleed Air Valves - OFF.
18. Air Conditioner - OFF.
19. Radar - OFF or STBY.
20. All Other Switches - OFF or NORM.
21. Battery Switch - EMER (check power to emergency bus items).

    With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment:

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Flight Display
DG 1	Pilot's and Copilot's Audio Panels	
Standby HSI	Voltmeter	

22. Battery Switch - BATT.
23. Battery Voltage - CHECK (24 volts minimum).
24. External Power - CONNECTED (if applicable).
25. Landing Gear Control - DOWN.
26. Landing Gear Lights - CHECK green lights illuminated and unlock light out.
27. Parking Brake - SET.
28. Avionics Power Switch(es) - ON (and AC, if applicable).
29. Rotary Test Switch - WARNING SYSTEMS CHECKED.

NOTE

The W/S TEMP annunciator may not test after cold soak at extremely cold temperatures. If this occurs, repeat the test after the cabin has warmed up. The test must be completed prior to flight.

30. Avionics Power Switch(es) - OFF.
31. Engine Instrument Warning Indicators - NO FLAGS.
32. Battery - OFF (If there is a delay before engine start, or ON with ground power unit).

QUICK TURNAROUND

1. Control Lock - OFF.
2. Generators - GEN (off if external power).
3. Boost Pumps - NORM.
4. Standby Gyro - ON/CHECK AMBER.
5. Throttles - CHECK OFF.
6. Pilot and Copilot Foot Warmers - OPEN
7. All Other Switches - OFF OR NORM.
8. Battery Switch - BATT.
9. Battery Voltage - CHECK (24 volts minimum).
10. External Power - CONNECTED (if applicable).
11. Landing Gear Control - DOWN.
12. Landing Gear Lights - CHECK.
13. Parking Brake - SET.
14. Engine Instrument Warning Indicators - NO FLAGS.

BEFORE STARTING ENGINES

1. Preflight Inspection - COMPLETE.
2. Wheel Chocks - REMOVED.
3. Cabin Door - CLOSE and LOCK. Check green indicators for proper door pin position, handle vertical and in detent.
4. Passenger Briefing - COMPLETE. (Include, seat/seat belt adjustment, emergency exits, smoking, and oxygen).
5. Seats, Seat Belts, Shoulder Harnesses and Rudder Pedals - ADJUST and SECURE.
6. Fuel Quantity - CHECKED.
7. Flashing Beacon Light - ON.
8. Air Conditioner - OFF.
9. Ground Idle Switch - NORM.

STARTING ENGINES

NOTE

- Either engine may be started first.
- If the aircraft has been cold soaked at temperatures below -12°C (10°F) and the engines have not been preheated, the use of external power or warming the battery to -12°C (10°F) or warmer is recommended. This temperature may be checked with the battery temperature gage. Proper battery warmup may require extended application of heat to the battery.

1. Flood and Center Panel Lights - FULL BRIGHT (for night operation).
2. Start Button - PRESS momentarily; Button Light - ILLUMINATES.
3. Throttle - IDLE at 8-10% N_2 (minimum).
4. ITT - CHECK for rise. Abort start if ITT rapidly approaches 550°C or shows no rise within 10 seconds.

NOTE

The temperature during ground start should not exceed 550°C. Temperatures exceeding this value should be investigated in accordance with the Engine Maintenance Manual.

5. Fan Speed - CHECK for indication of fan RPM with turbine RPM at 20% to 25%. Abort start if no fan RPM is shown by 25% turbine RPM.
6. Engine Instruments - CHECK NORMAL.
7. Fuel, Oil, Generator and Hydraulic Annunciators - EXTINGUISHED.
8. Ground Idle Switch - HIGH. Check high idle 51.5% turbine RPM Minimum.
9. Pressurization Source Selector - GND or NORM.

CAUTION

TURBINE SPEED GREATER THAN 53% ON THE OPERATING ENGINE WILL PRODUCE A GENERATOR OUTPUT WHICH MAY DAMAGE THE GENERATOR DRIVE DURING THE SECOND ENGINE START.

(Continued Next Page)

COCKPIT INSPECTION (Continued)

10. Standby Gyro Switch - TEST momentary; Check Green Light ON.
11. Standby Gyro - ON; Check Amber Light ON.
12. Antiskid - ON.
13. Ground Idle Switch - NORM.
14. Engine Synchronizer - OFF.
15. Throttles - CHECK OFF.
16. Pressurization Source Select - AS REQUIRED.
17. Windshield Bleed Air Valves - OFF.
18. Air Conditioner - OFF.
19. Radar - OFF or STBY.
20. All Other Switches - OFF or NORM.
21. Battery Switch - EMER (check power to emergency bus items).

    With the battery switch in EMER and the generators OFF, a properly charged battery will supply power for approximately 30 minutes to the following equipment:

COMM 1	LH and RH N_1 Tachometer	Overhead Floodlights
NAV 1	Standby Pitot and Static Heaters	Standby Airspeed Indicator/Altimeter
DG 1	Pilot's and Copilot's Audio Panels	Vibrator
Standby HSI	Voltmeter	

22. Battery Switch - BATT.
23. Battery Voltage - CHECK (24 volts minimum).
24. External Power - CONNECTED (if applicable).
25. Landing Gear Control - DOWN.
26. Landing Gear Lights - CHECK green lights illuminated and unlock light out.
27. Parking Brake - SET.
28. Avionics Power Switch(es) - ON (and AC, if applicable).
29. Rotary Test Switch - WARNING SYSTEMS CHECKED.

NOTE

The W/S TEMP annunciator may not test after cold soak at extremely cold temperatures. If this occurs, repeat the test after the cabin has warmed up. The test must be completed prior to flight.

30. Avionics Power Switch(es) - OFF.
31. Engine Instrument Warning Indicators - NO FLAGS.
32. Battery - OFF (If there is a delay before engine start, or ON with ground power unit).

QUICK TURNAROUND

1. Control Lock - OFF.
2. Generators - GEN (off if external power).
3. Boost Pumps - NORM.
4. Standby Gyro - ON/CHECK AMBER.
5. Throttles - CHECK OFF.
6. Pilot and Copilot Foot Warmers - OPEN
7. All Other Switches - OFF OR NORM.
8. Battery Switch - BATT.
9. Battery Voltage - CHECK (24 volts minimum).
10. External Power - CONNECTED (if applicable).
11. Landing Gear Control - DOWN.
12. Landing Gear Lights - CHECK.
13. Parking Brake - SET.
14. Engine Instrument Warning Indicators - NO FLAGS.
15. Standby Gyro Caging Knob - UNCAGED and NO FLAG.

BEFORE STARTING ENGINES

1. Preflight Inspection - COMPLETE.
2. Wheel Chocks - REMOVED.
3. Cabin Door - CLOSE and LOCK. Check green indicators for proper door pin position, handle vertical and in detent.
4. Passenger Briefing - COMPLETE. (Include, seat/seat belt adjustment, emergency exits, smoking, and oxygen).
5. Seats, Seat Belts, Shoulder Harnesses and Rudder Pedals - ADJUST and SECURE.
6. Fuel Quantity - CHECKED.
7. Flashing Beacon Light - ON.
8. Air Conditioner - OFF.
9. Ground Idle Switch - NORM.

STARTING ENGINES

NOTE

- Either engine may be started first.
- If the aircraft has been cold soaked at temperatures below -12°C (10°F) and the engines have not been preheated, the use of external power or warming the battery to -12°C (10°F) or warmer is recommended. This temperature may be checked with the battery temperature gage. Proper battery warmup may require extended application of heat to the battery.

1. Flood and Center Panel Lights - FULL BRIGHT (for night operation).
2. Start Button - PRESS momentarily; Button Light - ILLUMINATES.
3. Throttle - IDLE at 8-10% N_2 (minimum).
4. ITT - CHECK for rise. Abort start if ITT rapidly approaches 550°C or shows no rise within 10 seconds.

NOTE

The temperature during ground start should not exceed 550°C. Temperatures exceeding this value should be investigated in accordance with the Engine Maintenance Manual.

5. Fan Speed - CHECK for indication of fan RPM with turbine RPM at 20% to 25%. Abort start if no fan RPM is shown by 25% turbine RPM.
6. Engine Instruments - CHECK NORMAL.
7. Fuel, Oil, Generator and Hydraulic Annunciators - EXTINGUISHED.
8. Ground Idle Switch - HIGH. Check high idle 51.5% turbine RPM Minimum.
9. Pressurization Source Selector - GND or NORM.

CAUTION

TURBINE SPEED GREATER THAN 53% ON THE OPERATING ENGINE WILL PRODUCE A GENERATOR OUTPUT WHICH MAY DAMAGE THE GENERATOR DRIVE DURING THE SECOND ENGINE START.

(Continued Next Page)

STARTING ENGINES (Continued)

10. Other engine - START; repeat step 2 through 7.
11. Ground Idle Switch - NORM. Check both engines idle 46% turbine RPM Minimum.
12. External Power - CHECK CLEAR (if applicable).
13. Generators - GEN (if external power was used for start).

NOTE

When operating in visible moisture and ambient air temperature is +10°C or below, position ground idle switch to HIGH, turn pitot and static heat ON and engine LH and RH anti-ice systems ON. If temperature is above -18°C, turn W/S BLEED air switch to LOW. If temperature is -18°C or below, turn W/S bleed air switch to HI. Check W/S bleed air valves MAX. For sustained ground operation, the engines should be operated for one out of every four minutes at 65 percent turbine RPM or above.

BEFORE TAXIING

1. Air Conditioner, Fans, Temperature Control - AS REQUIRED.
2. Avionics Power Switch(es) - ON (and AC, if applicable)

NOTE

The avionics will require warmup after cold soak. Over 20 minutes may be required at temperatures below -30°C (-22°F). Proper warmup is indicated by normal illumination of frequency/code displays with pilot control of brightness and by audio reception on all applicable avionics. In the absence of a suitable station, background static is an acceptable demonstration of reception.

3. DC Amps/Volts - CHECK.
4. Battery Temperature - CHECK.
5. Passenger Advisory Lights - PASS SAFETY.
6. Pressurization - SET ALTITUDE and RATE.
7. Antiskid - CHECK ON.

NOTE

If the antiskid is turned off prior to or during taxiing, it must be turned on and the self-test sequence completed (antiskid annunciator light out) while the airplane is stationary prior to takeoff. If the airplane is taxiing when the antiskid system is actuated, the self-test sequence will not be completed successfully and the antiskid will not be operational during takeoff. Additionally, power braking will be inoperative for up to 6 seconds during the antiskid self-test.

8. Avionics Cooling Fans - CHECK OPERATING.
9. Standby Flight Display - CHECK/NO FLAG.

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BEFORE TAXIING (Continued)

10. Electric Elevator Trim - CHECK and SET; Operate electric elevator trim nose up and push AP/TRIM DISC switch. Verify elevator trim wheel stops rotating. Trim should not operate while pressing only one side of the split switch. Repeat check for nose down trim. Repeat trim check for copilot's AP/TRIM DISC switch. Set the trim as required for center-of-gravity.
11. Aileron and Rudder Trim - SET.
12. Autopilot - (at pilot's discretion) CHECK; engage, push pilot's A/P disconnect switch, verify A/P disconnect switch, verify A/P disconnects and disconnect chime sounds. Repeat on copilot's side.
13. Passenger Seats - CHECK FULL UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
14. Seats, Seat Belts and Shoulder Harnesses - CHECK SECURE
15. ATIS, Clearance and Flight Management System - CHECK.
16. Flaps - CHECK and SET.

NOTE

Verify flaps trim interconnect operation between 15 and 25 degrees.

17. Flight Controls - FREE AND CORRECT.
18. Avionics - CHECK AND SET. EFIS test button - PUSH, and pilot verify the following:
    a. Radio altimeter test value on pilot's and co-pilot's displays is 50 feet.
    b. All digit readouts replaced with dashes (except radio altimeter).
    c. All flags in view.
    d. Command cue (if selected) bias from view.
    e. Test light illuminates in upper left corner of PFD's.
19. Inverter Phase Angle - CHECK.
    a. Copilot's HDG REV Switch - PUSH, MAG 1 should annunciate on both PFDs.
    b. Pilot and Copilot Heading Displays - COMPARE.
    c. If Headings differ by 6° or more, Inverter No. 2 Circuit Breaker - PULL and RESET.
    d. Copilot's HDG REV Switch - PUSH to restore MAG 2 as heading source to Copilot's PFD.

NOTE

- The HDG REV button may require more than one push to select heading reversion mode. Reversion is verified by observing an amber MAG1 or MAG2, as appropriate, in each PFD.
- A significant heading difference indicates an excessive phase angle between inverters. This can adversely affect FMS, TCAS, and RADAR operation. Correct phase relation can be restored by pulling and resetting circuit breakers on either inverter.

20. AC Inverter Switch - CHECK INV 1 and INV 2. VERIFY gyro flags remain out of view and failed inverter is annunciated; then, Inverter Switch - NORM.
21. Cockpit Voice Recorder Test Button - PUSH and VERIFY operation.
    a. Erase Button - PUSH and HOLD for 2 seconds.
22. Lights - AS REQUIRED.

STARTING ENGINES (Continued)

10. Other engine - START; repeat step 2 through 7.
11. Ground Idle Switch - NORM. Check both engines idle 46% turbine RPM Minimum.
12. External Power - CHECK CLEAR (if applicable).
13. Generators - GEN (if external power was used for start).

NOTE

When operating in visible moisture and ambient air temperature is +10°C or below, position ground idle switch to HIGH, turn pitot and static heat ON and engine LH and RH anti-ice systems ON. If temperature is above -18°C, turn W/S BLEED air switch to LOW. If temperature is -18°C or below, turn W/S bleed air switch to HI. Check W/S bleed air valves MAX. For sustained ground operation, the engines should be operated for one out of every four minutes at 65 percent turbine RPM or above.

BEFORE TAXIING

1. Air Conditioner, Fans, Temperature Control - AS REQUIRED.
2. Avionics Power Switch(es) - ON (and AC, if applicable)

NOTE

The avionics will require warmup after cold soak. Over 20 minutes may be required at temperatures below -30°C (-22°F). Proper warmup is indicated by normal illumination of frequency/code displays with pilot control of brightness and by audio reception on all applicable avionics. In the absence of a suitable station, background static is an acceptable demonstration of reception.

3. DC Amps/Volts - CHECK.
4. Battery Temperature - CHECK.
5. Passenger Advisory Lights - PASS SAFETY.
6. Pressurization - SET ALTITUDE and RATE.
7. Antiskid - CHECK ON.

NOTE

If the antiskid is turned off prior to or during taxiing, it must be turned on and the self-test sequence completed (antiskid annunciator light out) while the airplane is stationary prior to takeoff. If the airplane is taxiing when the antiskid system is actuated, the self-test sequence will not be completed successfully and the antiskid will not be operational during takeoff. Additionally, power braking will be inoperative for up to 6 seconds during the antiskid self-test.

8. Avionics Cooling Fans - CHECK OPERATING.
9. Standby Gyro Caging Knob - UNCAGED/NO FLAG.

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BEFORE TAXIING (Continued)

10. Electric Elevator Trim - CHECK and SET; Operate electric elevator trim nose up and push AP/TRIM DISC switch. Verify elevator trim wheel stops rotating. Trim should not operate while pressing only one side of the split switch. Repeat check for nose down trim. Repeat trim check for copilot's AP/TRIM DISC switch. Set the trim as required for center-of-gravity.
11. Aileron and Rudder Trim - SET.
12. Autopilot - (at pilot's discretion) CHECK; engage, push pilot's A/P disconnect switch, verify A/P disconnect switch, verify A/P disconnects and disconnect chime sounds. Repeat on copilot's side.
13. Passenger Seats - CHECK FULL UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
14. Seats, Seat Belts and Shoulder Harnesses - CHECK SECURE
15. ATIS, Clearance and Flight Management System - CHECK.
16. Flaps - CHECK and SET.

NOTE

Verify flaps trim interconnect operation between 15 and 25 degrees.

17. Flight Controls - FREE AND CORRECT.
18. Avionics - CHECK AND SET. EFIS test button - PUSH, and pilot verify the following:
    a. Radio altimeter test value on pilot's and co-pilot's displays is 50 feet.
    b. All digit readouts replaced with dashes (except radio altimeter).
    c. All flags in view.
    d. Command cue (if selected) bias from view.
    e. Test light illuminates in upper left corner of PFD's.
19. Inverter Phase Angle - CHECK.
    a. Copilot's HDG REV Switch - PUSH, MAG 1 should annunciate on both PFDs.
    b. Pilot and Copilot Heading Displays - COMPARE.
    c. If Headings differ by 6° or more, Inverter No. 2 Circuit Breaker - PULL and RESET.
    d. Copilot's HDG REV Switch - PUSH to restore MAG 2 as heading source to Copilot's PFD.

NOTE

- The HDG REV button may require more than one push to select heading reversion mode. Reversion is verified by observing an amber MAG1 or MAG2, as appropriate, in each PFD.

- A significant heading difference indicates an excessive phase angle between inverters. This can adversely affect FMS, TCAS, and RADAR operation. Correct phase relation can be restored by pulling and resetting circuit breakers on either inverter.

20. AC Inverter Switch - CHECK INV 1 and INV 2. VERIFY gyro flags remain out of view and failed inverter is annunciated; then, Inverter Switch - NORM.
21. Cockpit Voice Recorder Test Button - PUSH and VERIFY operation.
    a. Erase Button - PUSH and HOLD for 2 seconds.
22. Lights - AS REQUIRED.

STARTING ENGINES (Continued)

10. Other engine - START; repeat step 2 through 7.
11. Ground Idle Switch - NORM. Check both engines idle 46% turbine RPM Minimum.
12. External Power - CHECK CLEAR (if applicable).
13. Generators - GEN (if external power was used for start).

NOTE

When operating in visible moisture and ambient air temperature is +10°C or below, position ground idle switch to HIGH, turn pitot and static heat ON and engine LH and RH anti-ice systems ON. If temperature is above -18°C, turn W/S BLEED air switch to LOW. If temperature is -18°C or below, turn W/S bleed air switch to HI. Check W/S bleed air valves MAX. For sustained ground operation, the engines should be operated for one out of every four minutes at 65 percent turbine RPM or above.

BEFORE TAXIING

1. Air Conditioner, Fans, Temperature Control - AS REQUIRED.
2. Avionics Power Switch(es) - ON (and AC, if applicable)

NOTE

The avionics will require warmup after cold soak. Over 20 minutes may be required at temperatures below -30°C (-22°F). Proper warmup is indicated by normal illumination of frequency/code displays with pilot control of brightness and by audio reception on all applicable avionics. In the absence of a suitable station, background static is an acceptable demonstration of reception.

3. DC Amps/Volts - CHECK.
4. Battery Temperature - CHECK.
5. Passenger Advisory Lights - PASS SAFETY.
6. Pressurization - SET ALTITUDE and RATE.
7. Antiskid - CHECK ON.

NOTE

If the antiskid is turned off prior to or during taxiing, it must be turned on and the self-test sequence completed (antiskid annunciator light out) while the airplane is stationary prior to takeoff. If the airplane is taxiing when the antiskid system is actuated, the self-test sequence will not be completed successfully and the antiskid will not be operational during takeoff. Additionally, power braking will be inoperative for up to 6 seconds during the antiskid self-test.

8. Avionics Cooling Fans - CHECK OPERATING.
9. Standby Gyro Caging Knob - UNCAGED/NO FLAG.

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BEFORE TAXIING (Continued)

10. Electric Elevator Trim - CHECK and SET; (Operate electric elevator trim nose up and push AP/TRIM DISC switch. Verify elevator trim wheel stops rotating. Trim should not operate while pressing only one side of the split switch. Repeat check for nose down trim. Repeat trim check for copilot's AP/TRIM DISC switch). Set the trim as required for center-of-gravity.
11. Aileron and Rudder Trim - SET.
12. Autopilot - (At pilot's discretion) CHECK; engage, push pilot's A/P disconnect switch, verify A/P disconnect switch, verify A/P disconnects and disconnect chime sounds. Repeat on copilot's side.
13. Passenger Seats - CHECK FULL UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
14. Seats, Seat Belts and Shoulder Harnesses - CHECK SECURE
15. ATIS, Clearance and Flight Management System - CHECK.
16. Flaps - CHECK and SET.

NOTE

Verify flaps trim interconnect operation between 15 and 25 degrees.

17. Flight Controls - FREE AND CORRECT.
18. Avionics - CHECK AND SET. EFIS test button - PUSH, and pilot verify the following:
    a. Radio altimeter test value on pilot's and co-pilot's displays is 50 feet.
    b. All digit readouts replaced with dashes (except radio altimeter).
    c. All flags in view.
    d. Command cue (if selected) bias from view.
    e. Test light illuminates in upper left corner of PFD's.
19. AC Inverter Switch - CHECK INV 1 and INV 2. VERIFY gyro flags remain out of view.
20. Cockpit Voice Recorder Test Button - PUSH and VERIFY operation.
    a. Erase Button - PUSH and Hold for 2 seconds.
21. Lights - AS REQUIRED.

STARTING ENGINES (Continued)

10. Other engine - START; repeat step 2 through 7.
11. Ground Idle Switch - NORM. Check both engines idle 46% turbine RPM Minimum.
12. External Power - CHECK CLEAR (if applicable).
13. Generators - GEN (if external power was used for start).

NOTE

When operating in visible moisture and ambient air temperature is +10°C or below, position ground idle switch to HIGH, turn pitot and static heat ON and engine LH and RH anti-ice systems ON. If temperature is above -18°C, turn W/S BLEED air switch to LOW. If temperature is -18°C or below, turn W/S bleed air switch to HI. Check W/S bleed air valves MAX. For sustained ground operation, the engines should be operated for one out of every four minutes at 65 percent turbine RPM or above.

BEFORE TAXIING

1. Air Conditioner, Fans, Temperature Control - AS REQUIRED.
2. Avionics Power Switch(es) - ON (and AC, if applicable)

NOTE

The avionics will require warmup after cold soak. Over 20 minutes may be required at temperatures below -30°C (-22°F). Proper warmup is indicated by normal illumination of frequency/code displays with pilot control of brightness and by audio reception on all applicable avionics. In the absence of a suitable station, background static is an acceptable demonstration of reception.

3. DC Amps/Volts - CHECK.
4. Battery Temperature - CHECK.
5. Passenger Advisory Lights - PASS SAFETY.
6. Pressurization - SET ALTITUDE and RATE.
7. Antiskid - CHECK ON.

NOTE

If the antiskid is turned off prior to or during taxiing, it must be turned on and the self-test sequence completed (antiskid annunciator light out) while the airplane is stationary prior to takeoff. If the airplane is taxiing when the antiskid system is actuated, the self-test sequence will not be completed successfully and the antiskid will not be operational during takeoff. Additionally, power braking will be inoperative for up to 6 seconds during the antiskid self-test.

8. Avionics Cooling Fans - CHECK OPERATING.
9. Standby Gyro Caging Knob - UNCAGED/NO FLAG.

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BEFORE TAXIING (Continued)

10. Electric Elevator Trim - CHECK and SET; (Operate electric elevator trim nose up and push AP/TRIM DISC switch. Verify elevator trim wheel stops rotating. Trim should not operate while pressing only one side of the split switch. Repeat check for nose down trim. Repeat trim check for copilot's AP/TRIM DISC switch). Set the trim as required for center-of-gravity.
11. Aileron and Rudder Trim - SET.
12. Autopilot - (At pilot's discretion) CHECK; engage, push pilot's A/P disconnect switch, verify A/P disconnect switch, verify A/P disconnects and disconnect chime sounds. Repeat on copilot's side.
13. Passenger Seats - CHECK FULL UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
14. Seats, Seat Belts and Shoulder Harnesses - CHECK SECURE
15. ATIS, Clearance and Flight Management System - CHECK.
16. Flaps - CHECK and SET.

NOTE

Verify flaps trim interconnect operation between 15 and 25 degrees.

17. Flight Controls - FREE AND CORRECT.
18. Avionics - CHECK AND SET. EFIS test button - PUSH, and pilot verify the following:
    a. Radio altimeter test value on pilot's and co-pilot's displays is 50 feet.
    b. All digit readouts replaced with dashes (except radio altimeter).
    c. All flags in view.
    d. Command cue (if selected) bias from view.
    e. Test light illuminates in upper left corner of PFD's.
19. AC Inverter Switch - CHECK INV 1 and INV 2. VERIFY gyro flags remain out of view.
20. Cockpit Voice Recorder Test Button - PUSH and VERIFY operation.
    a. Erase Button - PUSH and Hold for 2 seconds.
21. Lights - AS REQUIRED.

STARTING ENGINES (Continued)

10. Other engine - START; repeat step 2 through 7.
11. Ground Idle Switch - NORM. Check both engines idle 46% turbine RPM Minimum.
12. External Power - CHECK CLEAR (if applicable).
13. Generators - GEN (if external power was used for start).

NOTE

When operating in visible moisture and ambient air temperature is +10°C or below, position ground idle switch to HIGH, turn pitot and static heat ON and engine LH and RH anti-ice systems ON. If temperature is above -18°C, turn W/S BLEED air switch to LOW. If temperature is -18°C or below, turn W/S bleed air switch to HI. Check W/S bleed air valves MAX. For sustained ground operation, the engines should be operated for one out of every four minutes at 65 percent turbine RPM or above.

BEFORE TAXIING

1. Air Conditioner, Fans, Temperature Control - AS REQUIRED.
2. Avionics Power Switch(es) - ON (and AC, if applicable)

NOTE

The avionics will require warmup after cold soak. Over 20 minutes may be required at temperatures below -30°C (-22°F). Proper warmup is indicated by normal illumination of frequency/code displays with pilot control of brightness and by audio reception on all applicable avionics. In the absence of a suitable station, background static is an acceptable demonstration of reception.

3. DC Amps/Volts - CHECK.
4. Battery Temperature - CHECK.
5. Passenger Advisory Lights - PASS SAFETY.
6. Pressurization - SET ALTITUDE and RATE.
7. Antiskid - CHECK ON.

NOTE

If the antiskid is turned off prior to or during taxiing, it must be turned on and the self-test sequence completed (antiskid annunciator light out) while the airplane is stationary prior to takeoff. If the airplane is taxiing when the antiskid system is actuated, the self-test sequence will not be completed successfully and the antiskid will not be operational during takeoff. Additionally, power braking will be inoperative for up to 6 seconds during the antiskid self-test.

8. Avionics Cooling Fans - CHECK OPERATING.
9. Standby Gyro Caging Knob - UNCAGED/NO FLAG.

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BEFORE TAXIING (Continued)

10. Electric Elevator Trim - CHECK and SET; Operate electric elevator trim nose up and push AP/TRIM DISC switch. Verify elevator trim wheel stops rotating. Trim should not operate while pressing only one side of the split switch. Repeat check for nose down trim. Repeat trim check for copilot's AP/TRIM DISC switch. Set the trim as required for center-of-gravity.
11. Aileron and Rudder Trim - SET.
12. Autopilot - (at pilot's discretion) CHECK; engage, push pilot's A/P disconnect switch, verify A/P disconnect switch, verify A/P disconnects and disconnect chime sounds. Repeat on copilot's side.
13. Passenger Seats - CHECK FULL UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
14. Seats, Seat Belts and Shoulder Harnesses - CHECK SECURE
15. ATIS, Clearance and Flight Management System - CHECK.
16. Flaps - CHECK and SET.

NOTE

Verify flaps trim interconnect operation between 15 and 25 degrees.

17. Flight Controls - FREE AND CORRECT.
18. Avionics - CHECK AND SET. EFIS test button - PUSH, and pilot verify the following:
    a. Radio altimeter test value on pilot's and co-pilot's displays is 50 feet.
    b. All digit readouts replaced with dashes (except radio altimeter).
    c. All flags in view.
    d. Command cue (if selected) bias from view.
    e. Test light illuminates in upper left corner of PFD's.
19. Inverter Phase Angle - CHECK.
    a. Copilot's HDG REV Switch - PUSH, MAG 1 should annunciate on both PFDs.
    b. Pilot and Copilot Heading Displays - COMPARE.
    c. If Headings differ by 6° or more, Inverter No. 2 Circuit Breaker - PULL and RESET.
    d. Copilot's HDG REV Switch - PUSH to restore MAG 2 as heading source to Copilot's PFD.

NOTE

A significant heading difference indicates an excessive phase angle between inverters. This can adversely affect FMS, TCAS, and RADAR operation. Correct phase relation can be restored by pulling and resetting circuit breakers on either inverter.

20. AC Inverter Switch - CHECK INV 1 and INV 2. VERIFY gyro flags remain out of view and failed inverter is annunciated; then, Inverter Switch - NORM.
21. Cockpit Voice Recorder Test Button - PUSH and VERIFY operation.
    a. Erase Button - PUSH and HOLD for 2 seconds.
22. Lights - AS REQUIRED.

STARTING ENGINES (Continued)

10. Other engine - START; repeat step 2 through 7.
11. Ground Idle Switch - NORM. Check both engines idle 46% turbine RPM Minimum.
12. External Power - CHECK CLEAR (if applicable).
13. Generators - GEN (if external power was used for start).

NOTE

When operating in visible moisture and ambient air temperature is +10°C or below, position ground idle switch to HIGH, turn pitot and static heat ON and engine LH and RH anti-ice systems ON. If temperature is above -18°C, turn W/S BLEED air switch to LOW. If temperature is -18°C or below, turn W/S bleed air switch to HI. Check W/S bleed air valves MAX. For sustained ground operation, the engines should be operated for one out of every four minutes at 65 percent turbine RPM or above.

BEFORE TAXIING

1. Air Conditioner, Fans, Temperature Control - AS REQUIRED.
2. Avionics Power Switch(es) - ON (and AC, if applicable)

NOTE

The avionics will require warmup after cold soak. Over 20 minutes may be required at temperatures below -30°C (-22°F). Proper warmup is indicated by normal illumination of frequency/code displays with pilot control of brightness and by audio reception on all applicable avionics. In the absence of a suitable station, background static is an acceptable demonstration of reception.

3. DC Amps/Volts - CHECK.
4. Battery Temperature - CHECK.
5. Passenger Advisory Lights - PASS SAFETY.
6. Pressurization - SET ALTITUDE and RATE.
7. Antiskid - CHECK ON.

NOTE

If the antiskid is turned off prior to or during taxiing, it must be turned on and the self-test sequence completed (antiskid annunciator light out) while the airplane is stationary prior to takeoff. If the airplane is taxiing when the antiskid system is actuated, the self-test sequence will not be completed successfully and the antiskid will not be operational during takeoff. Additionally, power braking will be inoperative for up to 6 seconds during the antiskid self-test.

8. Avionics Cooling Fans - CHECK OPERATING.
9. Standby Flight Display - CHECK/NO FLAG.

(Continued Next Page)

BEFORE TAXIING (Continued)

10. Electric Elevator Trim - CHECK and SET; (Operate electric elevator trim nose up and push AP/TRIM DISC switch. Verify elevator trim wheel stops rotating. Trim should not operate while pressing only one side of the split switch. Repeat check for nose down trim. Repeat trim check for copilot's AP/TRIM DISC switch). Set the trim as required for center-of-gravity.
11. Aileron and Rudder Trim - SET.
12. Autopilot - (At pilot's discretion) CHECK; engage, push pilot's A/P disconnect switch, verify A/P disconnect switch, verify A/P disconnects and disconnect chime sounds. Repeat on copilot's side.
13. Passenger Seats - CHECK FULL UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
14. Seats, Seat Belts and Shoulder Harnesses - CHECK SECURE
15. ATIS, Clearance and Flight Management System - CHECK.
16. Flaps - CHECK and SET.

NOTE

Verify flaps trim interconnect operation between 15 and 25 degrees.

17. Flight Controls - FREE AND CORRECT.
18. Avionics - CHECK AND SET. EFIS test button - PUSH, and pilot verify the following:
    a. Radio altimeter test value on pilot's and co-pilot's displays is 50 feet.
    b. All digit readouts replaced with dashes (except radio altimeter).
    c. All flags in view.
    d. Command cue (if selected) bias from view.
    e. Test light illuminates in upper left corner of PFD's.
19. AC Inverter Switch - CHECK INV 1 and INV 2. VERIFY gyro flags remain out of view.
20. Cockpit Voice Recorder Test Button - PUSH and VERIFY operation.
    a. Erase Button - PUSH and Hold for 2 seconds.
21. Lights - AS REQUIRED.

STARTING ENGINES (Continued)

10. Other engine - START; repeat step 2 through 7.
11. Ground Idle Switch - NORM. Check both engines idle 46% turbine RPM Minimum.
12. External Power - CHECK CLEAR (if applicable).
13. Generators - GEN (if external power was used for start).

NOTE

When operating in visible moisture and ambient air temperature is +10°C or below, position ground idle switch to HIGH, turn pitot and static heat ON and engine LH and RH anti-ice systems ON. If temperature is above -18°C, turn W/S BLEED air switch to LOW. If temperature is -18°C or below, turn W/S bleed air switch to HI. Check W/S bleed air valves MAX. For sustained ground operation, the engines should be operated for one out of every four minutes at 65 percent turbine RPM or above.

BEFORE TAXIING

1. Air Conditioner, Fans, Temperature Control - AS REQUIRED.
2. Avionics Power Switch(es) - ON (and AC, if applicable)

NOTE

The avionics will require warmup after cold soak. Over 20 minutes may be required at temperatures below -30°C (-22°F). Proper warmup is indicated by normal illumination of frequency/code displays with pilot control of brightness and by audio reception on all applicable avionics. In the absence of a suitable station, background static is an acceptable demonstration of reception.

3. DC Amps/Volts - CHECK.
4. Battery Temperature - CHECK.
5. Passenger Advisory Lights - PASS SAFETY.
6. Pressurization - SET ALTITUDE and RATE.
7. Antiskid - CHECK ON.

NOTE

If the antiskid is turned off prior to or during taxiing, it must be turned on and the self-test sequence completed (antiskid annunciator light out) while the airplane is stationary prior to takeoff. If the airplane is taxiing when the antiskid system is actuated, the self-test sequence will not be completed successfully and the antiskid will not be operational during takeoff. Additionally, power braking will be inoperative for up to 6 seconds during the antiskid self-test.

8. Avionics Cooling Fans - CHECK OPERATING.
9. Standby Flight Display - CHECK/NO FLAG.

(Continued Next Page)

BEFORE TAXIING (Continued)

10. Electric Elevator Trim - CHECK and SET; (Operate electric elevator trim nose up and push AP/TRIM DISC switch. Verify elevator trim wheel stops rotating. Trim should not operate while pressing only one side of the split switch. Repeat check for nose down trim. Repeat trim check for copilot's AP/TRIM DISC switch). Set the trim as required for center-of-gravity.
11. Aileron and Rudder Trim - SET.
12. Autopilot - (At pilot's discretion) CHECK; engage, push pilot's A/P disconnect switch, verify A/P disconnect switch, verify A/P disconnects and disconnect chime sounds. Repeat on copilot's side.
13. Passenger Seats - CHECK FULL UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
14. Seats, Seat Belts and Shoulder Harnesses - CHECK SECURE
15. ATIS, Clearance and Flight Management System - CHECK.
16. Flaps - CHECK and SET.

NOTE

Verify flaps trim interconnect operation between 15 and 25 degrees.

17. Flight Controls - FREE AND CORRECT.
18. Avionics - CHECK AND SET. EFIS test button - PUSH, and pilot verify the following:
    a. Radio altimeter test value on pilot's and co-pilot's displays is 50 feet.
    b. All digit readouts replaced with dashes (except radio altimeter).
    c. All flags in view.
    d. Command cue (if selected) bias from view.
    e. Test light illuminates in upper left corner of PFD's.
19. AC Inverter Switch - CHECK INV 1 and INV 2. VERIFY gyro flags remain out of view.
20. Cockpit Voice Recorder Test Button - PUSH and VERIFY operation.
    a. Erase Button - PUSH and Hold for 2 seconds.
21. Lights - AS REQUIRED.

STARTING ENGINES (Continued)

10. Other engine - START; repeat step 2 through 7.
11. Ground Idle Switch - NORM. Check both engines idle 46% turbine RPM Minimum.
12. External Power - CHECK CLEAR (if applicable).
13. Generators - GEN (if external power was used for start).

NOTE

When operating in visible moisture and ambient air temperature is +10°C or below, position ground idle switch to HIGH, turn pitot and static heat ON and engine LH and RH anti-ice systems ON. If temperature is above -18°C, turn W/S BLEED air switch to LOW. If temperature is -18°C or below, turn W/S bleed air switch to HI. Check W/S bleed air valves MAX. For sustained ground operation, the engines should be operated for one out of every four minutes at 65 percent turbine RPM or above.

BEFORE TAXIING

1. Air Conditioner, Fans, Temperature Control - AS REQUIRED.
2. Avionics Power Switch(es) - ON (and AC, if applicable)

NOTE

The avionics will require warmup after cold soak. Over 20 minutes may be required at temperatures below -30°C (-22°F). Proper warmup is indicated by normal illumination of frequency/code displays with pilot control of brightness and by audio reception on all applicable avionics. In the absence of a suitable station, background static is an acceptable demonstration of reception.

3. DC Amps/Volts - CHECK.
4. Battery Temperature - CHECK.
5. Passenger Advisory Lights - PASS SAFETY.
6. Pressurization - SET ALTITUDE and RATE.
7. Antiskid - CHECK ON.

NOTE

If the antiskid is turned off prior to or during taxiing, it must be turned on and the self-test sequence completed (antiskid annunciator light out) while the airplane is stationary prior to takeoff. If the airplane is taxiing when the antiskid system is actuated, the self-test sequence will not be completed successfully and the antiskid will not be operational during takeoff. Additionally, power braking will be inoperative for up to 6 seconds during the antiskid self-test.

8. Avionics Cooling Fans - CHECK OPERATING.
9. Standby Flight Display - CHECK/NO FLAG.

(Continued Next Page)

BEFORE TAXIING (Continued)

10. Electric Elevator Trim - CHECK and SET; Operate electric elevator trim nose up and push AP/TRIM DISC switch. Verify elevator trim wheel stops rotating. Trim should not operate while pressing only one side of the split switch. Repeat check for nose down trim. Repeat trim check for copilot's AP/TRIM DISC switch. Set the trim as required for center-of-gravity.
11. Aileron and Rudder Trim - SET.
12. Autopilot - (at pilot's discretion) CHECK; engage, push pilot's A/P disconnect switch, verify A/P disconnect switch, verify A/P disconnects and disconnect chime sounds. Repeat on copilot's side.
13. Passenger Seats - CHECK FULL UPRIGHT, OUTBOARD and POSITIONED AFT or FORWARD to clear exit doors.
14. Seats, Seat Belts and Shoulder Harnesses - CHECK SECURE
15. ATIS, Clearance and Flight Management System - CHECK.
16. Flaps - CHECK and SET.

NOTE

Verify flaps trim interconnect operation between 15 and 25 degrees.

17. Flight Controls - FREE AND CORRECT.
18. Avionics - CHECK AND SET. EFIS test button - PUSH, and pilot verify the following:
    a. Radio altimeter test value on pilot's and co-pilot's displays is 50 feet.
    b. All digit readouts replaced with dashes (except radio altimeter).
    c. All flags in view.
    d. Command cue (if selected) bias from view.
    e. Test light illuminates in upper left corner of PFD's.
19. Inverter Phase Angle - CHECK.
    a. Copilot's HDG REV Switch - PUSH, MAG 1 should annunciate on both PFDs.
    b. Pilot and Copilot Heading Displays - COMPARE.
    c. If Headings differ by 6° or more, Inverter No. 2 Circuit Breaker - PULL and RESET.
    d. Copilot's HDG REV Switch - PUSH to restore MAG 2 as heading source to Copilot's PFD.

NOTE

A significant heading difference indicates an excessive phase angle between inverters. This can adversely affect FMS, TCAS, and RADAR operation. Correct phase relation can be restored by pulling and resetting circuit breakers on either inverter.

20. AC Inverter Switch - CHECK INV 1 and INV 2. VERIFY gyro flags remain out of view and failed inverter is annunciated; then, Inverter Switch - NORM.
21. Cockpit Voice Recorder Test Button - PUSH and VERIFY operation.
    a. Erase Button - PUSH and HOLD for 2 seconds.
22. Lights - AS REQUIRED.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Operating Procedures, Normal Procedures, p. 3-57, replace the TAKEOFF Procedure.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to p. 3-57.
Removal Instructions:	This temporary change supercedes 56FMA-TC-R11-01 in its entirety. This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Normal Procedures, p. 3-57, replace the TAKEOFF procedure as follows:

TAKEOFF

STATIC TAKEOFF

1. Throttles – SET TAKEOFF N_1.
2. Engine Instruments – CHECK NORMAL.
3. Brakes – RELEASE.

ROLLING TAKEOFF

1. Computed Takeoff Distance – ADD 500 FEET.
2. Brakes – RELEASE.
3. Throttles – SET TAKEOFF N_1 within 500 feet after brake release.
4. Engine Instruments – CHECK NORMAL.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Operating Procedures, Normal Procedures, Taxiing, replace step 5.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-57.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Normal Procedures, Taxiing, replace step 5 with the following:

TAXIING

5. Thrust Reversers – CHECKED and STOWED; CHECK SEQUENCING AND TIMING OF LIGHTS.

NOTE

The frequency of Thrust Reverser checks must be done as defined in Section II, Limitations.

APPROVED BY MMBaker

for Margaret Kline, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 3/9/06

TAXIING

1. Brakes - CHECK.

CAUTION

IF, DURING TAXI, A HARD BRAKE PEDAL - NO BRAKING CONDITION IS ENCOUNTERED, OPERATE THE EMERGENCY BRAKE SYSTEM. MAINTENANCE IS REQUIRED BEFORE FLIGHT.

2. Engine Instruments - CHECK NORMAL.
3. Flight Instruments - CHECK.
4. Speed Brakes - CYCLE.
5. Thrust Reversers - CHECKED and STOWED; CHECK SEQUENCING AND TIMING OF LIGHTS.
6. Pressurization Source Selector - NORM.
7. Deice Systems - CHECK (when icing conditions are anticipated).

CAUTION

DO NOT OPERATE DEICE BOOTS WHEN AMBIENT AIR TEMPERATURE IS BELOW -40°C (-40°F).

8. Anti-Ice Systems - CHECK.

CAUTION

LIMIT GROUND OPERATION OF PITOT/STATIC HEAT TO TWO MINUTES TO PRECLUDE DAMAGE TO THE ANGLE-OF-ATTACK SYSTEM.

9. V_1, V_R, V_2, Fan Speed Settings - Look up, Input and CONFIRM proper V speeds on PFD's.
10. Crew Briefing - COMPLETE.

BEFORE TAKEOFF

1. Passenger Seats - POSITION in accordance with associated placard.
2. Anti-collision Lights - ON.

NOTE

Do not operate the anti-collision lights in conditions of fog, clouds or haze as the reflection of the light beam can cause disorientation or vertigo.

3. Landing or Recognition Lights - AS DESIRED.
4. Flaps - SET FOR TAKEOFF
5. Trim - SET FOR TAKEOFF.
6. Transponder - ON.
7. Radar - ON.
8. Anti-Ice/Deice Systems - ON if required.
9. Ignition - ON.
10. Pitot/Static Heat - ON.
11. Annunciator Panel - CLEAR except GROUND IDLE light.

TAKEOFF

1. Throttles - SET for takeoff.
2. Engine Instruments - CHECK.
3. Brakes - RELEASE.

AFTER TAKEOFF - CLIMB

1. Landing Gear - UP.
2. Flaps - UP.
3. Ignition - NORM.
4. Climb Power - SET.
5. Engine Synchronizer - AS REQUIRED.
6. Yaw Damper - AS REQUIRED.
7. Passenger Advisory Lights - AS REQUIRED.
8. Anti-Ice/Deice Systems - AS REQUIRED.
9. Pressurization - CHECK.
10. Landing/Recognition Lights - OFF.
11. Altimeters - SET to 29.92 Hg (1013 mb/HPa) at transition altitude and CROSSCHECK.
12. Freon AC - OFF above 18,000 feet.
13. Cockpit Temperature Select - VERIFY AUTO (above 31,000 feet).

CRUISE

1. Cruise Power - SET.
2. Anti-Ice/Deice Systems - AS REQUIRED.

CAUTION

DO NOT OPERATE DEICE BOOTS WHEN INDICATED RAT IS BELOW -40°C (-40°F).

NOTE

- Check deice system for proper operation prior to entering areas in which icing might be encountered.
- Manual activation of the surface deice system may cause a mild pitch transient.
- The pilot's and copilot's footwarmers should be opened for a short period during cruise to purge the side windows of moist air. The foot warmers should be closed during descent.

DESCENT

1. Defog Fan - HI (minimum of 15 minutes prior to descent).
2. Pilot and Copilot Foot Warmers - CLOSE
3. Air Flow Distribution - COCKPIT.
4. Windshield Bleed Air Valves - MAX (AS REQUIRED).
5. Windshield Bleed Air Switch - LOW (AS REQUIRED).
6. ATIS/Clearance - AS REQUIRED.
7. Cabin Pressure Control - SET.
8. Anti-Ice/Deice Systems - AS REQUIRED.
9. Throttles - AS REQUIRED; maintain sufficient power for anti-icing (engine anti-ice lights remain OFF).
10. Altimeters - SET at transition altitude and CROSSCHECK.
11. Recognition Lights - ON.
12. Speed Brakes - AS REQUIRED.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes 560-0260 thru -0538.
Description of Change:	Section III, Operating Procedures, Normal Procedures, APPROACH, add a new caution and revise an existing caution.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-59.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Normal Procedures, add the following caution between steps 5 and 6 of the APPROACH procedures:

CAUTION

WITH THE ANTI-ICE SELECTED ON, THE V_{REF}/V_{APP} SPEEDS AND LANDING DISTANCES AND THE MAXIMUM LANDING WEIGHT PERMITTED BY CLIMB REQUIREMENTS OR BRAKE ENERGY LIMITS MUST BE ADJUSTED IN ACCORDANCE WITH FIGURE 4-34.

Revise the existing caution after the warning that follows step 14 as follows:

CAUTION

IN ICING CONDITIONS, A SMALL AMOUNT OF RESIDUAL ICE WILL FORM ON UNPROTECTED AREAS. THIS IS NORMAL, BUT CAN CAUSE AN INCREASE IN STALL SPEEDS. WHEN ANY AMOUNT OF RESIDUAL ICE IS VISIBLE, THE STALL SPEEDS IN FIGURE 4-7 MUST BE INCREASED BY 5 KNOTS; THE V_{REF}/V_{APP} SPEEDS, LANDING DISTANCES AND THE MAXIMUM LANDING WEIGHT PERMITTED BY CLIMB REQUIREMENTS OR BRAKE ENERGY LIMITS MUST BE ADJUSTED IN ACCORDANCE WITH FIGURE 4-34.

APPROVED BY MM Baker

for Margaret Kline, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

DATE OF APPROVAL 10/2/07

APPROACH

1. Seats, Seat Belts and Shoulder Harnesses - SECURE.
2. Avionics and Flight Instruments - CHECK.
3. Radar Altimeter - SET.
4. Landing Speeds - (V_{APP} and V_{REF}) - Look up, Input and CONFIRM.
5. Landing Data (N_1, Landing Distance, Weight, and Factors) - CONFIRM.
6. Crew Briefing - COMPLETE.
7. Passenger Advisory Lights - PASS SAFETY.
8. Passenger Seats - POSITION in accordance with associated placard.
9. Flaps - APPROACH.
10. Engine Synchronizer - OFF.
11. Ground Idle Switch - NORM; or HIGH (if ground icing anticipated, or for touch and go landing).
12. Fuel Crossfeed - OFF.
13. Antiskid - CHECK ON.
14. Recognition Lights - ON.

WARNING

WITH ANY RESIDUAL ICE PRESENT DO NOT ATTEMPT TO FLY UNCORRECTED V_{REF}/V_{APP} SPEEDS. STALL SPEEDS INCREASE AND ENGINE ANTI-ICE MUST BE SELECTED ON TO MAINTAIN ADEQUATE STALL WARNING MARGINS.

CAUTION

IN ICING CONDITIONS, A SMALL AMOUNT OF RESIDUAL ICE WILL FORM ON UNPROTECTED AREAS. THIS IS NORMAL, BUT CAN CAUSE AN INCREASE IN STALL SPEEDS. WHEN ANY AMOUNT OF RESIDUAL ICE IS VISIBLE, THE STALL SPEEDS IN FIGURE 4-7 INCREASE BY 5 KNOTS; THE V_{REF}/V_{APP} SPEEDS, LANDING DISTANCES AND THE MAXIMUM LANDING WEIGHT PERMITTED BY CLIMB REQUIREMENTS OR BRAKE ENERGY LIMITS MUST BE ADJUSTED IN ACCORDANCE WITH FIGURE 4-32.

NOTE

- When reconfiguring for approach and landing (i.e., flaps extended and gear down), and any ice accretion is visible on the wing leading edge, regardless of thickness, activate the surface deice system. Continue to monitor the wing leading edge for any reaccumulation.
- For increased rates of descent in icing conditions, the use of landing flaps is recommended. This will allow a higher power setting greater than 75% N_2, if necessary, to maintain engine anti-icing capabilities.

BEFORE LANDING

1. Landing Gear - DOWN and LOCKED.
2. Landing Lights - AS DESIRED.
3. Ignition - ON.
4. Flaps - LAND.
5. Airspeed - V_{REF}.
6. Autopilot and Yaw Damper - OFF.
7. Annunciator Panel - CLEAR.
8. Pressurization - CHECK ZERO DIFFERENTIAL.
9. Speed Brakes - RETRACTED PRIOR TO 50 FEET.

LANDING

1. Throttles - IDLE.

NOTE

Eight seconds after touchdown, engines will spool down from flight idle to ground idle if the flight idle switch is in NORM position.

2. Brakes - APPLY (after touchdown).

CAUTION

IF, DURING LANDING, A HARD BRAKE PEDAL - NO BRAKING CONDITION IS ENCOUNTERED, OPERATE THE EMERGENCY BRAKE SYSTEM. MAINTENANCE IS REQUIRED BEFORE NEXT FLIGHT.

NOTE

To obtain maximum braking performance from the antiskid system, the pilot must apply continuous maximum effort (no modulation) to the brake pedals.

3. Control Wheel - APPLY FORWARD PRESSURE.

CAUTION

THE NOSEWHEEL MUST BE IN FIRM CONTACT WITH THE GROUND PRIOR TO EXTENDING SPEED BRAKES AND/OR DEPLOYING THRUST REVERSERS.

4. Speed Brakes - EXTEND (after nosewheel firm ground contact).
5. Thrust Reversers - DEPLOY (after nosewheel firm ground contact).

WARNING

DO NOT ATTEMPT TO RESTOW REVERSERS AND TAKEOFF ONCE REVERSERS HAVE STARTED TO DEPLOY.

NOTE

- To prevent any possible nose up pitch during thrust reverser deployment, maintain forward pressure on the control column after the nose wheel is on the ground.

- To avoid possible jamming of the throttle lockout cams, do not exceed approximately 15 pounds force on the thrust reverser levers until thrust reversers are fully deployed.

6. Reverser Indicator Lights - CHECK ILLUMINATION OF ARM, UNLOCK AND DEPLOY LIGHTS.
7. Reverse Power - AS REQUIRED (do not exceed 76.6% N_1 when OAT is below -18°C or 80.1% N_1 at or above -18°C OAT).
8. Thrust Reversers - REVERSER LEVERS TO IDLE REVERSE AT 60 KIAS.

TEMPORARY FAA APPROVED AIRPLANE FLIGHT MANUAL CHANGE

Publication Affected:	Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual, Revision 11, dated 2 October 2001.
Airplane Serial Numbers Affected:	Airplanes (560-0260 thru -0538) incorporating SB560-32-27.
Description of Change:	Section III, Operating Procedures, Normal Procedures, change a CAUTION and delete text.
Filing Instructions:	Insert this temporary change in the Model 560 Citation Ultra (560-0260 thru -0538) basic FAA Approved Airplane Flight Manual adjacent to page 3-60.
Removal Instructions:	This temporary change must be removed and discarded when Revision 12 has been collated into the basic FAA Approved Airplane Flight Manual.

In Section III, Operating Procedures, Normal Procedures, LANDING, change the CAUTION after item 3 and delete text in parenthesis for item 4:

CAUTION

THE NOSEWHEEL MUST BE IN FIRM CONTACT WITH THE GROUND PRIOR TO DEPLOYING THRUST REVERSERS.

4. Speed Brakes – EXTEND.

ALL ENGINES GO-AROUND

1. Thrust - SET FOR TAKEOFF.
2. Airplane Pitch Attitude - POSITIVE Rotation To +10 Degrees (use flight director go-around mode).
3. Flaps - TAKEOFF and APPROACH.
4. Climb Speed - V_{APP}.
5. Landing Gear - UP (when positive rate of climb is established).
6. Flaps - UP.
7. Thrust - SET FOR CLIMB.

AFTER LANDING

1. Thrust Reversers - STOW.

CAUTION

DO NOT ADVANCE THROTTLES UNTIL THE THRUST REVERSER UNLOCK LIGHTS ARE OUT.

2. Flaps - UP.
3. Ignition - NORMAL.
4. Pitot/Static Heat - OFF.
5. Speed Brakes - RETRACT.
6. Anti-Collision Lights and Recognition Lights - OFF, if necessary.
7. Anti-Ice/Deice Systems - OFF.
8. Transponder - OFF or STANDBY.
9. Radar - OFF or STANDBY.

SHUTDOWN

1. Avionics Power Switch(es) - OFF.
2. Defog Fan - OFF.
3. Air Conditioner - OFF.
4. Flaps - TAKEOFF and APPROACH.
5. Throttles - OFF after allowing ITT to stabilize at minimum value for one minute.
6. Passenger Advisory Lights - OFF.
7. Flashing Beacon Light - OFF.
8. Standby Gyro Switch - OFF.
9. Exterior Lights - OFF.
10. Control Lock - ENGAGE.
11. Parking Brake - SET or Wheels - CHOCK.

NOTE

- If brakes are very hot, do not set parking brake.
- Do not set parking brake if the anticipated cold soak temperature is -15°C (5°F) or below.

12. Battery Switch - OFF.
13. Engine Covers - INSTALL (after engines have cooled).

TURBULENT AIR PENETRATION

Flight through severe turbulence should be avoided if possible. The following is recommended for flight in severe turbulence.

1. Ignition - ON.
2. Airspeed approximately 180 KIAS. Do not chase airspeed.
3. Maintain a constant attitude without chasing the altitude. Avoid sudden large control movements.
4. Operation of the autopilot is recommended using basic pitch hold and lateral mode only.

ANTI-ICE ADDITIVES

PROCEDURE FOR ADDING ETHYLENE GLYCOL MONOMETHYL ETHER (EGME) FUEL ADDITIVE

Use the following procedure to blend anti-icing additive as the airplane is being refueled through the wing filler caps:

1. Attach MIL-I-27686 additive to refuel nozzle, making sure blender tube discharges in the refueling stream.

2. Start refueling while simultaneously fully depressing and slipping ring over trigger of blender.

WARNING

ANTI-ICING ADDITIVES CONTAINING ETHYLENE GLYCOL MONOMETHYL ETHER (EGME) ARE HARMFUL IF INHALED, SWALLOWED OR ABSORBED THROUGH THE SKIN, AND WILL CAUSE EYE IRRITATION. ALSO, IT IS COMBUSTIBLE. BEFORE USING THIS MATERIAL, REFER TO ALL SAFETY INFORMATION ON THE CONTAINER.

CAUTION

ASSURE THAT THE ADDITIVE IS DIRECTED INTO THE FLOWING FUEL STREAM AND THAT THE ADDITIVE FLOW IS STARTED AFTER THE FUEL FLOW STARTS AND IS STOPPED BEFORE FUEL FLOW STOPS. DO NOT ALLOW CONCENTRATED ADDITIVE TO CONTACT COATED INTERIOR OF FUEL TANK OR AIRPLANE PAINTED SURFACE. USE NOT LESS THAN 20 FLUID OUNCES OF ADDITIVE PER 156 GALLONS OF FUEL OR MORE THAN 20 FLUID OUNCES OF ADDITIVE PER 104 GALLONS OF FUEL.

(Continued Next Page)

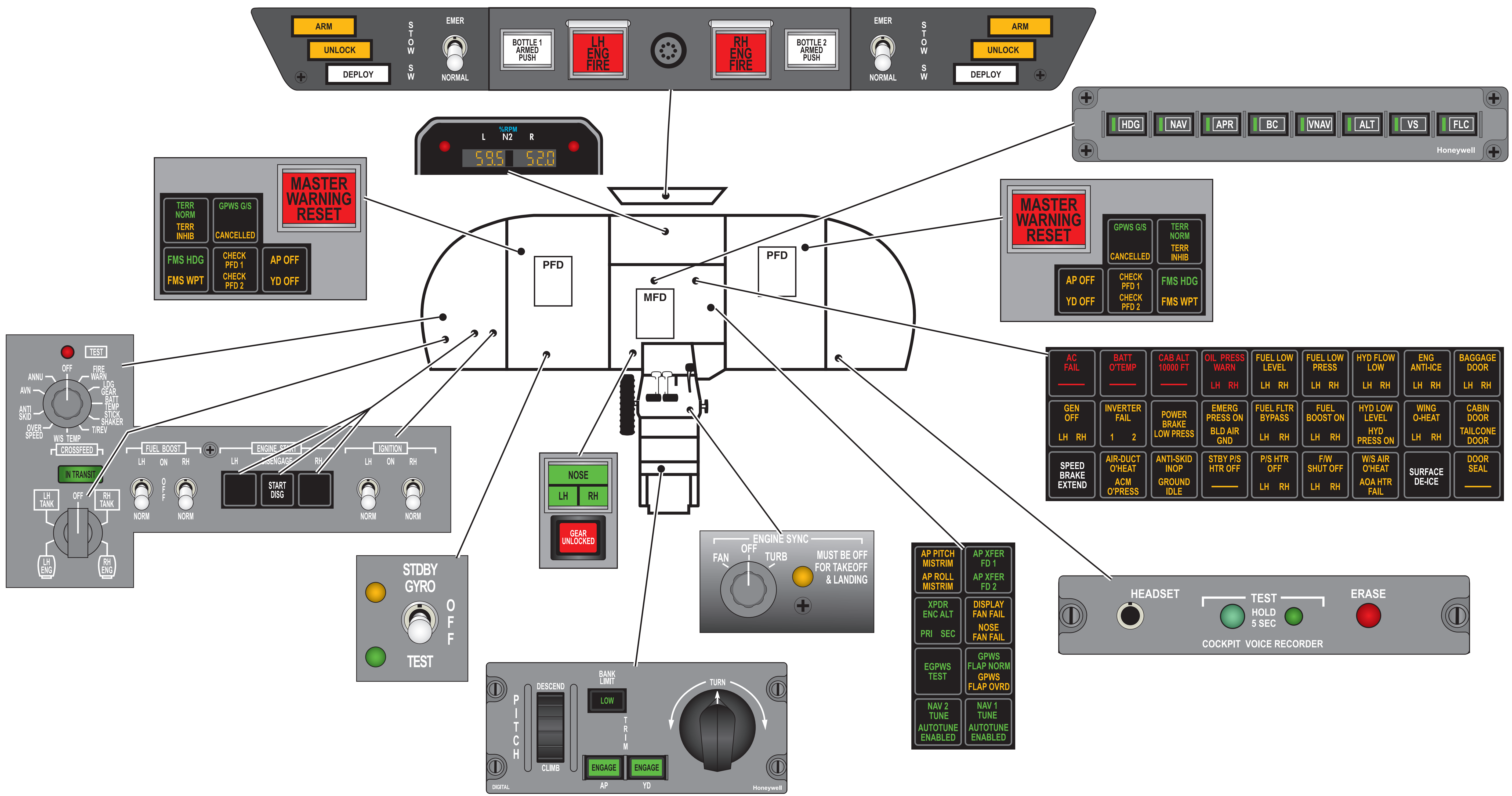

Figure ANN-1. Annunciators—SNs 0401 and On